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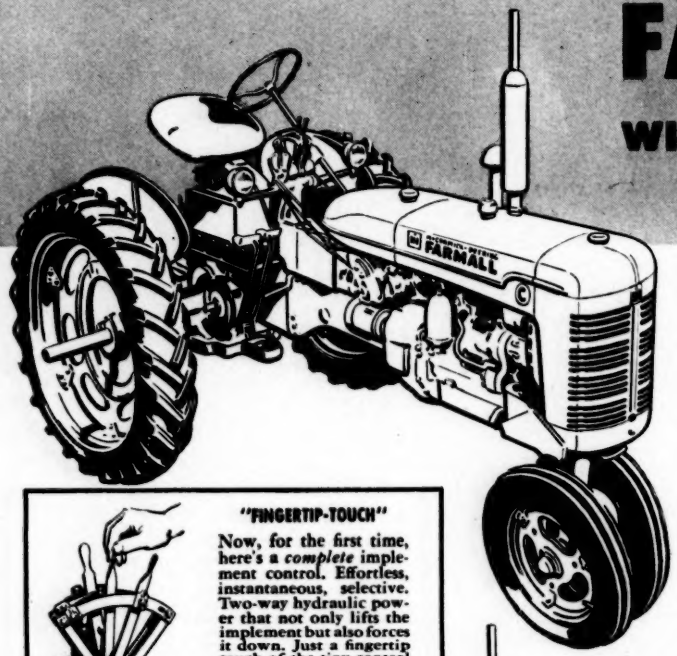

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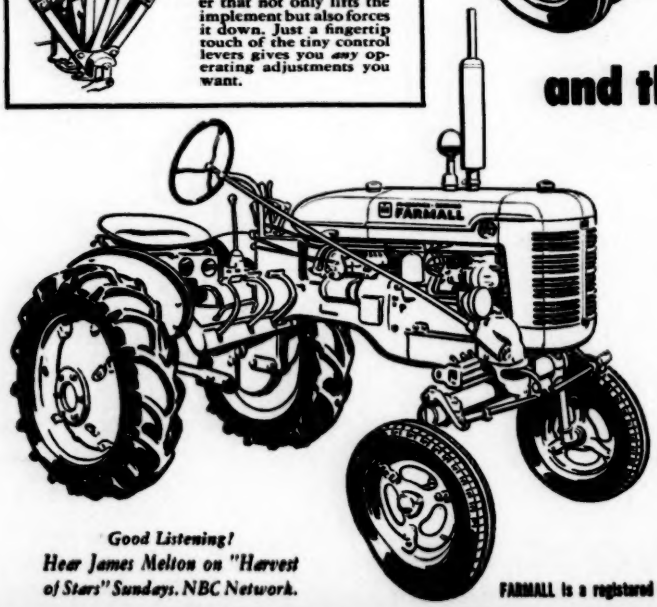

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VOLUME 3
NUMBER 1

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This JOURNAL is owned, edited, and published quarterly by the Soil Conservation Society of America.

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TERRACES.. "Eaves troughs" for Your Farm

PICTURED here is Exhibit A in the case against soil erosion, a test tube filled with water from the mud-swollen Missouri River. There is unmistakable evidence in the ⅜-inch layer of fertile silt which has settled to the bottom of this glass tube. Here is a revealing sample of the *100,000,000 tons* of topsoil swept away every year by this one river alone. When spring and summer rains begin, the Missouri's sediment load jumps from 10,000 to 3,000,000 tons a day. That's the topsoil equivalent of a 100-acre farm every five minutes.

Something can and is being done about it. Like almost every farming territory, the Missouri watershed needs "eaves troughs" — terraces and contour strips to control runoff water. Allis-Chalmers is co-operating with soil conservation engineers in demonstrating tractor methods of terracing with moldboard and disc plows, strip cropping, constructing ponds, waterways and reservoirs.

All these operations can be done with regular home-owned tractor equipment. Costly graders and heavy crawler tractors are no longer required.

By holding rain water on the slopes, modern tractor plows are providing life-giving moisture to crops and healing the cancerous erosion eating into our farmlands.

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EDITORIAL COMMENT

This issue of the JOURNAL features two important papers—both presented at the Omaha meeting of the Society—that are far-reaching in their recognition of the need for a basic land use policy upon which to build a permanent agriculture. Mr. E. H. Taylor's paper entitled "Our Changing Land Policy," which appears on the opposite page, is the most important contribution on this subject to come before the people of the Nation. The statement is far-reaching because it contains an outline that embodies the principles of a new national land use policy.

The paper by Charles F. Brannan, Assistant Secretary of Agriculture, entitled "A Permanent Agriculture," discusses the food needs of a growing population and relates that need to our available land resources. He further emphasizes the fact that an abundant agriculture is dependent upon a basic conservation plan—not only for the Nation, but also for each individual farm and ranch. It is obvious, therefore, that a good land use policy is needed upon which to base a good food policy. This fact is clearly evident in both papers.

Mr. Taylor's paper is a direct contradiction of its title. To use his own words—"We have no past land policy to change. We have no present or future land policy to which we are changing."

Of interest to anyone who is concerned with conservation will be his factual description of land management neglect and mishandling from a period that goes back to the establishment of our independence. Today's conservation efforts he terms valuable contributions to a changing trend in the general attitude toward the land "but they do not constitute a policy." As he explains it, "a policy would be an enactment by Congress, establishing the conservation of the nation's soil and water resources as a declared purpose of Government and adjusting other programs and policies to it."

His suggested outline for a definite policy is encouraging. It would state:

"That it is hereby recognized that the conservation and maintenance of our basic food-producing resources are essential to the national security and to the physical and economic well being of the American people; that the wastage of our soil and water resources, resulting from soil erosion, loss of soil fertility, flood damage and the silting of our streams, lakes and reservoirs, has become of critical national concern; that the enactment of a permanent national land policy, for the purpose of conserving these basic resources, is necessary to prevent their further exhaustion and the consequent endangering of the national security and the physical and economic well being of the American people; and that this national land policy shall be established and used as a foundation for other agricultural policies and programs.

This issue of the JOURNAL comes off the press with a new format, the first major change in make-up during its brief period of existence. We hope you will like it.

The change in size, color, and other features follows the present trend in periodicals. Our aim is to retain the JOURNAL's professional appearance and accuracy. Future issues will contain more technical articles, illustrations, field observations and advertising. In addition, we plan to provide a better distribution of subject-matter related to the different fields of conservation coming from contributors in all parts of the country. Foreign features are also to be included.

You may think of other ways in which you would like to have the JOURNAL serve you, or there may be additional changes in make-up that would improve the appearance and usefulness. Your recommendtaions will be considered.

Dr. Firman E. Bear, Chairman, Department of Soils, Rutgers University, and editor of *Soil Science* won the 1947 JOURNAL award given by the Society for the article judged most beneficial and appealing by the membership. "The Real Value of Soil Organic Matter" was the title of Dr. Bear's article. The award will be made again for 1948.

Twenty-two articles were considered by the membership in making the final selection. 1051 different articles were marked, thereby providing a most interesting study of the likes and dislikes of the members insofar as the content of the JOURNAL was concerned. A review of the several placings indicates that technical and informative articles containing practical data rated high. This, we believe, is as it should be.

R. D. Hockensmith's article, "Scientific Basis for Conservation Farming," placed second; "A Symposium —The Ecological Approach to Land Use," by Graham, Harris, and Ackerman, third; "Aspects of Protecting Storage Reservoirs by Soil Conservation" by Carl B. Brown, fourth; and "Economics of Soil and Water Conservation" by Elmer L. Sauer, fifth.

There were many outstanding papers presented at the meeting of the Society held in Omaha early last December. Four of the papers appear in this issue of the JOURNAL. Others are scheduled for publication in future issues. It may not be possible, however, to publish all the papers presented because of the demand for current material. Should a member want a particular paper that has not appeared in the JOURNAL, it is suggested that he write to the author or the editor of the JOURNAL. Copies will be provided.

"Our Changing Land Policy"

E. H. TAYLOR

"Thus far there has been no genuine land policy in and for the United States. True enough, there have been temporizing plans, some of them good for a time, and for certain sections. But a plan involving and comprehending the welfare of the whole nation . . . we have not had."—B. H. Hibbard.

This paper by E. H. Taylor, Associate Editor of *Country Gentleman*, is by far the most important statement on "Our Changing Land Policy" that has come to the attention of the people of America. It was presented at the Second Annual meeting of the Soil Conservation Society of America, held in Omaha, Nebraska, December 4, 1947, and was considered a highlight of the meeting. Mr. Taylor in a statesmanlike manner, clearly sets forth the need for a National Land Policy and, related to this need, the influence of our mistakes. Conservationists, agricultural leaders, and others in all walks of life, will find this paper stimulating and enlightening. It should be "must" reading for the professional conservationist.—Editor.

AFTER LONG AND TROUBLED reflection I have concluded that your program committee contains some practical jokesters. They gave me a subject entitled *"Our Changing Land Policy."* It was kindly suggested that if I traced some of the significant historical changes in our land policy it might help us all to understand better how and why we got where we are now—and where we might be going.

I have earnestly tried to carry out this assignment. In my efforts to find that land policy, which I was asked to describe to you, I have read a dozen or so books dealing with the administration of this nation's land and have delved into a number of Congressional debates and enactments. And now a firm respect for truth and honesty compels me to say that I cannot live up to the promise made on your program. To trace and interpret *"Our Changing Land Policy"* just can't be done, for reasons that should become apparent to you before long.

It has been said "If we know the past, we can better understand the present." How true that statement is I never quite realized until I began this intensive study of our land history. In greater part it is a history of what happened to a public domain, vaster and richer than ever possessed by any other nation. In its entirety this public domain embraced one billion 300 million acres, acquired by conquest, cession, purchase and outright occupation. Within less than a century and a half it had all been disposed of—settled and farmed, devoted to grazing use, logged over and mined or set aside into national reserves.

By what manner of means was all this turnover of land accomplished? What were the acts of far-sighted statemanship and the wise principles which shaped the distribution and treatment of this mighty store of natural resources? Here surely we should find signs of that land policy, which my subject assumes. But the historian-economist, Benjamin Horace Hibbard, author of perhaps the best work on our land history, has only this to say:

"While there were many individuals with interesting, even excellent, ideas as to how the public domain should be administered, it cannot be said that a conscious policy worthy of the name existed. . . It was rather a series of expedient actions."

Public Domain was a Source of Revenue

The curtain lifts on the first of these actions involving the land soon after independence was achieved. The

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E. H. Taylor is an Associate Editor of Country Gentleman and an occasional writer for the Saturday Evening Post. He has a first hand knowledge of agricultural resources and problems for his work has taken him into forty-six of the states. Mr. Taylor was born and reared on a farm in Woodson County, Kansas, homesteaded by his grandfather. His interest in conservation was first aroused when he saw what soil erosion was doing to the farms and streams of his old home community.

This Wyoming scene was taken in 1870 by W. H. Jackson, official photographer for the Hayden Expedition. The foreground shows a luxuriant growth of western wheat grass in virgin condition. This same area is now covered with sagebrush.

young Republic was in debt and it had few sources of revenue. But it owned an unsettled territory, stretching from Ohio to the Mississippi, more than 265,000,000 acres, acquired by defeat of England and by cession from the original colonies. The statesmen of the time saw in it one of the means of solving their financial problem. Both the Land Ordnance of 1785, in which Thomas Jefferson had a hand, and Alexander Hamilton's Report to Congress on the Public Lands held that the public domain should constitute a source of national revenue through the gradual sale of land.

For more than a third of a century this emphasis on the revenue function of the land was to prevail. But there was little agreement otherwise.

At the very start there was a sharp difference of opinion whether the land should be sold in large blocks to land settlement companies—and speculators—or in small acreages suited to the financial ability of the settler, at auction or to the individual buyer. The result was a compromise—one of so many that were to develop. The auction method was adopted. Land was sold in large blocks—to the Ohio Company, the Scioto Company and others, in one of which, I am sorry to say, Congressmen were the promoters. It was also sold in settler-sized blocks.

The land history of the next quarter of a century is a long series of controversies—over the price of land, the terms of credit and extensions of payment. Prices started off at a minimum of $1 an acre, were raised to $2 an acre, but with concessions to land companies that were sometimes as low as 16 cents an acre. Credit terms began at one-half down and the rest in two years. This time limit for final payments was lengthened to three, then to five years. When settlers became hard pressed Congress frequently voted extensions, depending on whether the Eastern or Western viewpoint prevailed.

For land was ensnarled in one of the many conflicts of interests, which have marked our history. The West, seeking new settlers and development, wanted low land prices and easy terms. But the East feared the loss of its population and the increasing political power of the West. Its growing industrialism wanted a plentiful and cheap labor supply, which every easing of land settlement made harder to hold.

So the historian, writing of that period, merely comments: "No policy developed for making the best or most logical use of the public domain."

But one marked change took place in 1824. As a result of unprofitable experience, the credit system was abolished. Almost as an incidental after-thought Con-

gress attached a reduction in the price of land to $1.25 an acre. It was the beginning of a trend—away from the emphasis on the public lands as a source of revenue and toward an emphasis on the human values they might serve.

Benton's Philosophy of the Land

Lending a powerful voice to this trend was the appearance in the Senate of one of the great figures in our land history—Thomas H. Benton of Missouri. He was pontificial, egostistical and no doubt often irritating to his fellow Senators. But he deserved the title of Statesman of the West, and he looms as one of our few Statesmen of the Land.

In a series of speeches in the 1820's he advocated graduated land prices and even the free settlement of land. "The freeholder," he declared, "is the natural supporter of a free government, and it should be the policy of republics to multiply their freeholders. Pass the public lands easily and cheaply into the hands of the people; sell, for a reasonable price, to those who are able to pay; and give, without price, to those who are not. I say, give without price to those who are not able to pay, and that which is so given I consider as sold for the best of prices."

Settlement and cultivation, he maintained, were the true means of increasing wealth and the national income. Revenue could be derived from the sale of land but once, he asserted, while the land, settled and under cultivation, would be a source of "endless future production."

Senator Benton did not achieve any of his objectives at the time. But he planted seed that was to bear abundant fruit later on. And he invested land with a social purpose that was to carry on down to our day in the stress on the family-owned and operated type of farm.

The historian comments: "Benton did not originate a policy so much as a philosophy of the land. Great changes, it is true, were to follow along the lines of his thinking. But they were not the products of any orderly program but rather of circumstances that rendered them advantageous for other reasons."

His ideas failed at the time because land became involved in another of those struggles between conflicting interests. From Hamilton's time the Federal government had two main sources of revenue—duties on imports and income from the sale of public lands. In the first forty-five years sales of these lands totalled 87,538,347 acres, yielding a considerable outlay of money to a Government that then cost little. But by Jackson's second administration the Government could see itself soon out of debt. There was, in consequence, less need for revenue. The South was hostile to the tariff and wanted lower duties or none at all. The West wanted cheaper land prices or, better, free land.

The industrial East was alarmed over both possibilities. Here the adroit Henry Clay began a series of stratagems. He entered into an agreement with John C. Calhoun for the retention but gradual lowering of the tariff. And he proposed that the proceeds of the land sales be distributed among the states. The guise was to promote internal improvements, but the intent was to keep up the price of land by arousing the covetousness of the states. This proposal was brought up at one session of Congress after another until it was finally passed in the form of a deposit of the Government's surplus funds with the states. But the deposits continued less than a year, for then the panic of 1837 was on and the Federal Treasury was broke.

It was not the first—or the last—time that politics was to sacrifice the welfare of the land.

Grants of Land Made for Improvements

But another influence, more powerful than politics, was soon to enter upon the scene. From the outset grants of land for various public purposes had become an accepted practice. They had been awarded as military bounties and for the protection of the frontier. Section 16 in each township had been set aside to promote education. In all, through this original act, a further grant in 1841, and the Morrill Act in 1862, for the establishment of agricultural colleges, the Government gave more than 100 million acres for educational purposes.

Then, as the newly settled areas began to demand outlets, grants were made for wagon roads, canals and river improvements.

These gifts tended to shape a phase of the popular and official attitude toward the land—it was something that could be exchanged for improvements that the people wanted. This paved the way for a development that was to hasten land settlement and to shift the historical balance of interests in this country. It was the coming of the railroads and the grants of land to promote their construction.

The first of these land grants to subsidize the building of railroads was made in 1850, with the Illinois Central the recipient. Alternate sections of land for six miles on either side of the railroad—or their equivalent if the land was already settled—were given to the states through which the Illinois Central was to pass. The land was to be sold and the proceeds turned over to the railroad's builders. The price of the public land intervening between these railroad-grant sections was raised to $2.50, on the theory that the benefit conferred by the railroad increased its value to that extent.

Before the period of railroad building, financed in

The Government's failure to classify lands resulted in the promotion of fraud and corruption and the exploitation and waste of virgin stands of timber, soil and other renewable natural resources.

part by land gifts, was ended the Government was to make total grants for that purpose of 91,239,389 acres and the states 37,789,169 acres. The wisdom and justice of these land grants, the means by which some of them were obtained, the subsequent use of these railroad lands all have been subjects of question and controversy. I shall not enter into their merits. But I do venture the opinion that no other factor had so revolutionizing an effect on the course of our land history.

With the advent of the railroads, the industrial East began to realize the possibilities of the Western markets and to become more favorable to rapid land settlement. Easy and comparatively fast transportation opened up distribution outlets for industrial goods. In return the abundance of cheap food from the West relieved the pressure on wages. The great mineral and lumber resources of the West were made accessible, with Eastern capital the chief beneficiary. The Northern and Western alliance began. It was to have historical repercussions.

HOMESTEAD ACT WAS A REAL SUCCESS

The first of these was a more friendly attitude toward homestead—or free land—proposals. Such spokesmen as Horace Greeley and William H. Seward reversed their former positions and became champions of a homestead law. A Pennsylvania Congressman—Galusha Grow—became the chief advocate of homesteads. A pre-emption or "squatters' rights" act, termed by one historian "the first democratization of the public land," had been passed in 1841. Homesteading had been officially approved for the Oregon territory. The spirit of Manifest Destiny was pushing the nation to the shores of the Pacific, and giving the settlement of the intervening territory an urgent importance. From 1840 on some form of homesteading act was introduced at nearly every session of Congress.

It seemed Benton's dream was about to be fulfilled. But land again became involved in a political issue—the struggle between the slave and the free states. Southern leaders saw that the small landholder, who would be multiplied by a homestead act, would prove a barrier to the extension of the plantation, slave-farming system. Anti-slavery interests were equally quick to see the same fact. So, for fifteen years, homesteading was delayed by this deepening conflict between political and economic interests. A hybrid homestead act was vetoed by Buchanan in 1859 in deference to his Southern supporters.

The victory of the new Republican Party in 1860 insured the passage of the Homestead Act. It was delayed by the needs of the Treasury, but only until 1862.

With the Homestead Act a period in our land history ended and another began. The public lands ceased to be regarded as a source of revenue. Their use for the subsidization of railroads was to attain still larger proportions, but it is significant that the year 1871 saw the last railway grant. The rapid settlement and cultivation of the public lands by an independent, home-owning population had become recognized as their best use.

Like all Government actions in respect to the land, it was late. Two-thirds of the land, suited to homesteading, had already been occupied. There were other failures of foresight in connection with it. Yet this comment by one land historian seems fair: "With all its shortcomings, the Homestead Act has more to its credit than any other one act passed by the Federal Government. A million and a third homesteads were taken up and carried to completion under it." Some of us here were to grow up on homesteaded farms.

It did not constitute a policy, only the culmination of a long tendency to make land easier of settlement. Nor did it bring order into our land affairs. The Homestead Act was based on experience in the settlement of the Middle Country. It broke down when it attempted to cross the Plains and enter an area of different climatic conditions.

Here, as in all of the Government's land activities, one grave deficiency was to have costly effects. This was the failure to classify the public lands—the very essence of a rational land policy. Thus, for the first half century, all land, good and bad, sold for virtually the same price; and, under the Homestead Act, all public land was considered equally adapted to entry in 160-acre tracts, regardless of the character of the land or its geography.

Exploitation of Resources was Great

Under this blind and improvident system enormously valuable mineral and timber lands were to pass into private hands for a pittance in comparison to their real values. The results were an incalculable loss to the Federal Treasury, the promotion of fraud and corruption and the exploitation and waste of natural resources. There were other by-products, still all too familiar. The lands west of the 100th meridian became the scene of ill-fated attempts at homesteading settlement, of wars between the "nesters" and the rangemen, and of tragic failures and disappointments to thousands of homesteaders.

The wise advice of Major J. W. Powell, one of our first and greatest land scientists, was disregarded. After a survey of the West he recommended that what is now mostly range country should be settled in large tracts, suited to pasturage. Instead Congress attempted to repair the flaws in the Homestead Act by numerous pieces of patchwork legislation: The Kinkaid Act, the Enlarged Homestead Act, the Stock-raising Homestead Act, the Timber Culture Act, the Desert Land Act, the Carey Act and still others. But no act of Congress could enable a homestead-farmer to succeed on land that nature intended to be grazed by animals. The limitations of geography, and not the wisdom of Government, have had to work out the solution to this problem of land use.

Not until 1891, when most of the public domain had passed into private hands and much of the most valuable parts had been possessed by the railroads and the mining and lumber interests, did Congress act to protect the little remaining against exploitation. It then passed a General Revision Act of all land legislation. And not until 1907, in Theodore Roosevelt's Administration, did the first real movement for the conservation of our natural resources take shape. But it was mainly concerned with waterpower, timber and minerals. The first official move toward conservation of our greatest natural resource—the land—was to wait another quarter of a century.

I believe the review of our land history might properly end here. All of you are familiar with the subsequent actions of the Government—the Reclamation Act, the legislation establishing the Soil Conservation Service and the Agricultural Adjustment Act. In their merits, and in their shortcomings, they are in keeping with the rest of our land record. None of them attains the rank of a land policy, although they might contain the seed of such a policy.

The destruction of our soil resources cannot be blamed on the pioneer settlers, but rather on the Government of the United States for the failure to enact policies that would guard against exploitation.

Government Responsible for Exploitation of Land

Somehow, after such a fashion as I have outlined, the land of this country has been settled and turned to use. Of all our mighty store of land resources, less than 100,000,000 acres remain to be reclaimed by the costly processes of drainage or irrigation. It is a sadly mixed history—this occupation of the world's greatest land empire. If we consider only the courage, the hardihood, the sacrifices and the resolution of the pioneer settlers we can well feel a glow of pride. In all too many histories and official documents these pioneer settlers have been held up as "soil robbers" and blamed for the wastage and destruction of our natural resources. There were, among them, some who were guilty of such abuses—through ignorance, greed or shiftlessness.

But here and now I intend to put the principal blame for the dissipation of our land resources exactly where it belongs—on the Government of the United States and on the men who constituted that Government from time to time. By their improvident and shortsighted actions, they set the example for a wasteful attitude toward the land. By their failure to enact policies that would safeguard the disposal of the public lands they encouraged speculation, fraud and exploitation. By making land

the football of politics, they set back the type of development that would have best served the interests of the nation. The miracle is that the development of our land resources turned out as well as it has. For that fact we can thank the intelligence, the spirit and the enterprise of a majority of the people who have settled and cultivated the land. As to the record of the Government in that respect, I shall quote the remark of perhaps the best qualified historian on that subject:

"Thusfar there has been no genuine land policy in and for the United States. True enough, there have been temporizing plans, some of them good for a time, and for certain sections. But a plan involving and comprehending the welfare of the whole nation . . . we have not had."

Now you understand why I am unable to carry out the assignment given me by the program committee. *We have had no past land policy to change. We have no present or future land policy to which we are changing.*

What we have had have been trends in the prevailing attitude toward the land. What we have now is a changing trend, one toward the maintenance of our land resources. Like the trend toward the use of the land to encourage an independent, home-owning citizenry, this also has had its seer and spokesman. He is Hugh H. Bennett. One of the few things of which I am proud is that I first met him, and helped a little, when he was still a lone voice crying in the wilderness. He it was who first really awakened the country to the irreparable loss it was suffering from soil erosion—from all the ravages of water, wind and neglect that were deplenishing our land resources. He not only saw the need, he had the constructive ability to bring together in a practical program the practices that would insure a good stewardship of the land. If history is just it will list Hugh H. Bennett as one of the half dozen most useful Americans of our time.

PEOPLE ARE AHEAD OF GOVERNMENT

But again, as with Benton, the trend he initiated is slow of achievement. Our land history is being repeated —the needed action always late. And again, as in our past, it is the people who are ahead of the government. The farmers themselves, and not Washington, are now the chief motive force in the trend toward conservation of our land resources. They are realizing more and more that the soil is their primary capital asset, and that its proper use and care is the first commandment of good farming. I have been impressed by the number of them who have appeared before the Congressional committees and put soil conservation first, asking that benefit payments be made only for those practices that will be of permanent value in maintaining the productivity of the soil. The huge crowds that have attended the demonstrations of complete conservationizing of farms signify the wide farm interest. In a recent poll in Wallace's Farmer as to who is the most successful farmer, by far the largest vote was cast for "the one who follows the best soil conservation practices." The men who have received these awards here tonight represent the way real farmers are coming to feel about conservation of their soil.

Sportsmen now see that wildlife conservation is inseparably linked with soil and water conservation. Wildlife must have food and cover and clean streams if it is to exist. Only the conservation of our soil and water resources will provide these essentials.

Again, as with the homestead idea, the trend is gradually gaining the support of business interests. Bankers are learning that an eroding farm means a declining security for a loan or a dwindling deposit in the bank. The implement companies and other suppliers of farm equipment are enlisting behind conservation because only productive land will afford them an enduring market. The local business men in the thousands of small towns, who depend upon farm trade, are beginning to understand that the soil is the sole basis of purchasing power in their areas. The meaning of conservation is also taking hold in a larger sense. I quote from an editorial in the *Kansas City Star*, entitled "The Land That Feeds Us:"

"The soil losses in the Middle West this year concern every American housewife who has to pay at the butcher's counter. They concern the poorly fed Europeans who wait for American shipments. But here in the Missouri Basin the issue is far greater. The future of Kansas City, Topeka, Omaha and all the other cities in the Missouri Valley depends on stopping the wasting away of the land that supports them. There is no alternative. . . Soil conservation is a national 'must.' It is an absolute essential to the whole flood control program. It goes far beyond the reservoirs and levees to keeping the soil on the land and water on the soil. Flood control and soil conservation roll together into one vast program—keep the soil on the land, keep all the water on the land that the soil will hold, harness the water resources of the basin for the use of man. We had better wake up to the fact that soil and water are the sources of life."

All of these are valuable contributions to a changing trend in the general attitude toward the land. But they do not constitute a policy. *A policy would be an enactment by Congress, establishing the conservation of the*

nation's soil and water resources as a declared purpose of Government and adjusting other programs and policies to it. This we do not have, and it isn't going to be easy to get. The land has again become involved in another issue—the world struggle now going on between different social systems. For the time being the short-term needs of our foreign policy seem likely to take priority over all else—even the interests of the land. Actually a sound land policy is the strongest arm of any long-time foreign policy, as will shortly become evident. But there is another reason why such a policy is not in sight. It is the simple fact that a majority of those who presently make up our government do not realize any better than those of the past the paramount importance of our food producing resources to the progress, stability and destiny of this country.

Land Greatest Factor in Social and Economic Development

Let us, for the sake of the record, make clear their full meaning to the life of the nation. It is my considered opinion that the abundance of our food-producing resources has been the greatest single factor in the social and economic development of this country. There are conclusive reasons for that opinion and I shall state them now:

1. The bounteousness and variety of our food supply, coming from a comparatively new soil, have given us a vigorous and energetic population throughout our history. Only a people, well nourished and strong, could have accomplished so much in so short a time. For corroboration and for its significance to our future, I shall quote a statement by Dr. George R. Minot of the Har-

A national land policy should relate the "ultimate need for food" and the basic importance of our soil resources to the economy and security of the nation.

vard School of Medicine, who said recently: "Initiative, progress, success and the happiness of a people tend to go hand in hand with an abundance of food and a good diet."

2. An adequate supply of food has been one of the strongest supports of our free political institutions. We are having demonstrated to us, on the present world stage, how precarious is the life of governments where the food supply is inadequate. Hunger is the greatest threat to the stability of any form of government. We have never had to face it here. There have been times when some of our people did not have enough to eat. But those occasions were due to the failure of political and social leadership, never to a shortage of food.

3. Our vast industrial development would have been impossible without an abundance of food. The processing and marketing of food is in itself our biggest single industry, drawing upon innumerable others for materials and equipment. But in another and still more significant way our food resources have facilitated the growth of our complex industrial system. With the single exceptions of the periods following the two world wars, food has not only been plentiful but cheap. This insured a labor force physically capable of doing the work. More important, it left a large margin of earnings to be spent on the products of industry. Over the long record kept by the Department of Agriculture the food basket has accounted for little more than 20 per cent of the average spendable income. Nowhere else in the world has it been possible to satisfy the food needs of a people and have so much of a balance left to be used in raising the common standard of living. I wonder if the men in industry realize what it will mean if we let our soil resources continue to decline until we become like other lands. Suppose that margin above food requirements drops to 70, to 60, to 50 per cent of the spendable income, what will happen to industry, to labor?

4. The three essentials in war are: Manpower, weapons and food. A nation without adequate food resources and with its supply lines destroyed is a defeated nation. Never, in all our wars, have we had to worry about an ample supply of food. We have been able to take full care of ourselves and to provision our allies as well. God grant that we may never suffer another war, but if we do we can be sure that a sufficient food supply will be as vital as in the past. A reserve of productivity, stored in the soil, will be as necessary as a stockpile of bombs or other weapons.

5. The products of our soil have been and are now one of the strongest forces for success in our foreign relations. All but forgotten is the fact that for three-quarters of a century they accounted for our favorable balance of trade, enabling us to pay off the capital investments foreigners made here when we were a creditor nation. We know well what they mean now. They are the most powerful arm of our foreign policy. Without them the Marshall Plan or any other effort to stay the march of Communism in Europe would be impotent. Our food producing resources will be no less indispensable to an effective foreign policy in the future. Upon their maintenance depends our strength at home and the ability to produce the surplus supplies needed to back up our foreign policy. A sound land policy does not run counter to our foreign policy; it is its strongest support.

6. The maintenance of our food-producing resources is the very foundation of our national security. Our rival for world leadership is master of the greatest storehouse of natural resources left on earth. But we have ruined one-fifth of our original grant of tillable land and we are using up the remainder faster than it is being restored. All history holds for us the lesson of nations that ignored the waning of their food resources. Their epitaph is written in the Book of Isaiah: "Thy speech shall whisper out of the dust."

And yet, in the face of all of these facts so vital to the destiny of the nation, this is what an eminent land historian has to report: "During the century and a third, over which our legislation has extended, there has been little attempt to couple land policies with the ultimate need for food."

Isn't it time that we had such a policy, one that comprehends this "ultimate need for food" and the basic importance of our soil resources to the economy and security of the nation?

You and I know the answer well enough but too many other people do not. The necessary job ahead is to make the facts known, to bring home to these others the element of their own self-interest that is at stake. And, as the facts plainly show, the interests of all—city as well as country—are involved. The present condition of scarcity and high prices of certain primary foods is but a preview of what will be normal fifteen or twenty years from now if the present deterioration of our soil goes on unchecked. I am not an alarmist but I saw what the floods of last sping did to the richest of our farm lands.

There are obstacles to be overcome—the still persistent myth of land plenty; the historic tendency of Congress to adopt temporizing measures instead of the needed reality; the subordination of the land to other interests and issues; the uncalled for fight over who shall administer the conservation program; and the "parlor conservationists," who would go to extremes as in their present war on the range cattlemen.

But these obstacles can be overcome. I have faith that

(Continued on page 56)

A Cultural Basis for Education in Conservation

PAUL A. MILLER

THIS MOST STIMULATING paper by Paul A. Miller, a former West Virginia County Agriculture Agent, and now Extension Specialist in Rural Sociology and Anthropology, Michigan State College, approaches the problem of conservation education and leadership from an entirely new viewpoint. Mr. Miller says that conservation must become a cultural trait of the people before it will be generally accepted. All this, he further emphasizes, is closely related to human relationship "systems" that are guided by accepted cultural traits and influence. These must be understood by the agricultural worker if new programs and ideas are to be successfully introduced.

EACH EDUCATIONAL PROCESS has several factors in common. One factor that the sociologist often takes as a basic theme is the original position of people in the educational sequence of events. More simply, the problem becomes one of starting where people are in terms of their ideas. The kind of contribution which any local program makes depends on the needs as felt by the people to be affected. Soil conservationists, county agricultural agents, ministers, health and school authorities, librarians, and many other workers who deal with local groups, are all confronted with integrating new ideas and practices into the everyday activities of the people.

People and human welfare are included among the important ends or objectives in the conservation of natural resources. The execution of complete farm plans, and the application of the practices they contain, are related to assisting farm families in developing and maintaining productive, healthy, and gracious living on the land. Whether one's own ends are oriented more closely to people and social welfare, or to the tremendous need for conserving natural resources, actually makes little difference. Both are interrelated, and both objectives are concerned with the educational process.

Acceptance of Conservation Based on Culture

People are everywhere characterized by a set of skills, methods, and technological processes by which they support themselves, and carry on the functions of living. As well, a multitude of habits and customs are included which define the normal ways of conduct. When such means and materials for doing things are coupled with the normal ways of conduct, a system of values and sentiments results which places emphasis, or value, or weight, on what is done and how it is done. Such a mixture of skills, habits and customs, and the sentiments of people, all go to form their culture. Every local group in the process of considering a program of soil and water conservation lives by culture, lives in culture, and the members contribute to it in their own way, passing it along to children, neighbors, and friends.[1]

Culture patterns also provide for the manner in which human beings organize their lives. In this organization people have certain kinds of human relationships, which are organized within comparatively broad extremes of space, frequency, and intensity. Moreover, within the framework of such human relationships certain individuals possess positions of superordination, while others fall into positions of subordination. Simply given, one may say that *every organized group, informal or formal, is characterized by those who are leaders and those destined to be followers.* The purpose of this paper is related to the manner in which human relationships and the leaders involved in them are relevant to successful educational programs in soil and water conservation. Some basic definitions adhered to in this paper are indicative of this latter statement.

> "Leadership is a process of mutual stimulation which, by the successful interplay of relevant individual differences, controls human energy in the pursuit of a common cause." (1)

In this manner, leadership involves the total group concerned, rather than the lone activities of the leader.

> "A leader is an individual who is moving in a particular direction and who succeeds in inducing others to follow after him." (2)
>
> "We may define any person as a follower during the time when, and in so far as, he accepts and is directed by the will, feeling, and insight of another in the pursuit of a cause which that other represents." (1)

Breakdown in Educational Process Retards Conservation

One worthy objective in educational programs concerned with soil and water conservation is that the conservation or stewardship of the land and its resources becomes a humanly natural "value" of the people. Many of those concerned with the educational process in conservation have realized that a broadside, or "cafeteria-style," educational programs do not always bring desired results. Moreover, experience in the field demonstrated to many that the completion of a farm plan for soil and water conservation likewise does not always guarantee that application of the practices will be made.

[1]See the following for elaborations on the concept of culture: Ruth Benedict, *Patterns of Culture*, Houghton Mifflin, Boston, 1934; Bronislaw Malinowski, *A Scientific Theory of Culture*, The University of North Carolina Press, Chapel Hill, 1944; Ralph Linton, *The Cultural Background of Personality*, Appleton-Century, New York, 1945.

Among other reasons, this discrepancy between planning and action is fed by breakdowns in the educational process, meaning that somewhere along the line conservation as a "value" was not fully (3) accepted. The acceptance of conservation in such a positive manner would mean that local group sanctions would operate, tending to informally enforce, as a prestige factor, the application and the carrying through of proper conservation measures. Conserving soil and other natural resources would then become a cultural trait, and it is reasonable to expect that new gains could be made in reducing improper land use. For several years the author has been fascinated by the real progress being made in proper soil and water conservation. At the same time he has been interested in adaptations to our educational process in conservation activities that would enable stewardship of the land to join the ranks of cultural traits in the society in a more rapid manner.

One of the adaptations that give promise of better orientation of conservation to the local culture patterns and needs of the people is that of developing insights into existing systems of (4) human relationships. The specific aspect being treated here is that of such human relationships being focused about leaders in their local groups. The manner in which new insights by the conservationist into human relationships may implement conservation acceptance rests on two basic assumptions. The first is concerned with efficient expenditures of time and energy of workers in the district, or others concerned with conservation programs. Agreement is usually reached on the promise of better use of time if groups of people are carried through the conservation and farm planning process, rather than the indiscriminate selection of participants based on individual (4) interests. The second assumption is directly related to the educational process. It concerns the increased results possible when a local group possessing already natural ties formulates its mutual problem in conservation, and proceeds to cooperatively plan for and act on the problem. For many this latter assumption offers fruitful promise in that conservation is cast into the natural stream of organized human life in the area concerned. It enables the conservationist to initiate his activities at the level where people find themselves, and placing conservation need into the midst of normal, natural, and everyday life.

Human Relationship Patterns at Hallers Corners

In this whole problem, then, the part of the social scientist may well be one of research into the structure of human relationships, leaders included. The remainder of this paper concerns itself with an experimental attempt to define patterns of human relationships that are culturally defined. The setting is the somewhat typical southern Michigan County of Livingston.

Rural people in Livingston County (5) have organized their lives into rather distinct levels of human activity. These range all the way from small informal silo filling groups to the activities of the great metropolitan area of Detroit. One such level is the one focused about the many small hamlets and villages in the county. These have been termed "extended neighborhoods." One of these neighborhoods, Hallers Corners, will be described from the point of view of the patterns of human relationships contained within it.

The area covered by the name of Hallers Corners consists of some thirty families, occupies four square miles of territory, and is geographically centered by a small church. This small church is the only formal institutional group in the neighborhood. Hallers Corners falls within an earlier soil conservation project area, and is now a part of the Fenton Soil Conservation District. The chairman of the Board of Directors for the district is a resident in the neighborhood. At the time of the study two additional families were cooperators with the district.

During the course of the author's investigation each family was visited and interviewed relative to a number of categories of desired information. One such category was that of encouraging each family head or wife to choose those families in the neighborhood that were considered in strong and influential positions of leadership.

"In your opinion, who are the families in this neighborhood that have become the leaders, and have been accepted as such by the folks in the neighborhood?" This was the question that concluded an interview with each family in the neighborhood.

Church Influences Local Leadership

At the time of the investigation, the matter of whether one belonged to the local church was a sharp issue for discussion. Such attitudes toward local church membership were pronounced among both old residents and the newcomers. Families of long residence in the neighborhood tended to maintain firm identifications with the local church, while the newcomers had developed relatively more weak contacts. The "old-timers" that were church members reported, in general, that the supply of social advantages in the neighborhood was adequate; while non-church families were more critical of the desirability of life in the neighborhood. Eight families were closely identified with the church at the time of the study. Seven families were moderately affiliated, and sixteen were not affiliated. Such was the setting of Hallers Corners in the late months of 1946. Important for the purpose of this paper is that the positive and negative attitudes taken by people in the neighborhood about the local church were important aspects of the total culture context. The remaining task is one of pointing out the

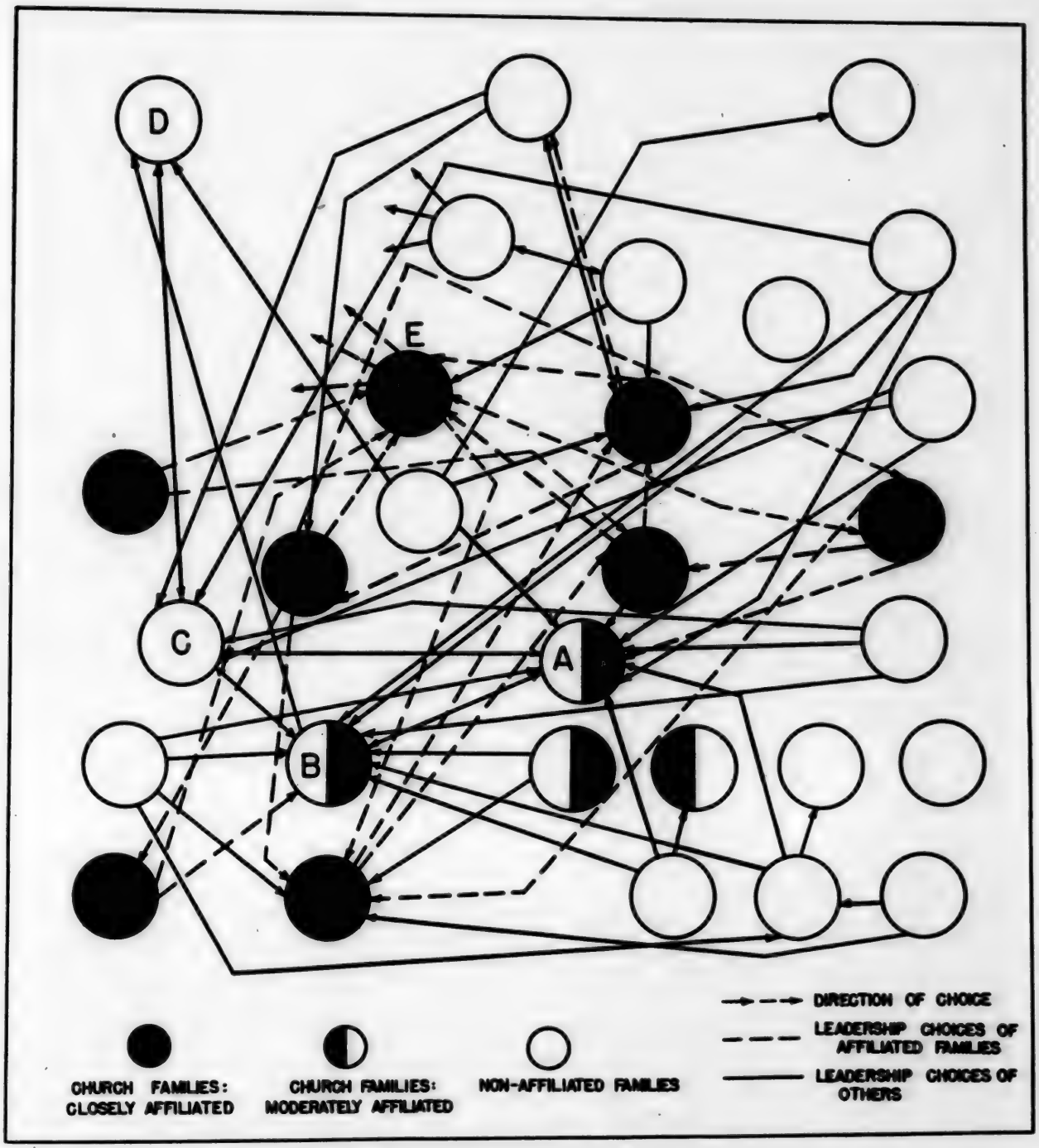

Figure 1.—The circles represent families in approximate geographical relationship to each other. Black circles represent closely affiliated church families; partially black circles portray loosely affiliated church families, and circles free of shading correspond to those families not affiliated with the church. The arrows represent selections of leaders; broken lines corresponding to selections of closely affiliated church families, and solid lines indicating selections of loosely and non-affiliated church families. Family E is the leader of the church families; while families A, B, and C are the leaders of the loosely and non-affiliated church families. Such leader selections indicate two systems of human relationships in the neighborhood—both of which are related to degrees of affiliation with the local church.

connection between such a central "value" and the systems of human relationships.

A close reference to Figure 1 will assist the reader in interpreting these data. In the first instance, Figure 1 demonstrates the results of the leadership selections made by each family in Hallers Corners. One arrow represents one selection, being drawn from the family making a selection to the family selected. The few arrows not terminated represent selections of families outside the neighborhood. It is necessary to note from Figure 1 that the broken lines represent the selections of closely affiliated local church families, while the solid lines or arrows represent the selections of nonaffiliated or moderately affiliated families.

Closely affiliated church families in the neighborhood selected families of the same church affiliated group as leaders. Non-affiliated or moderately affiliated families selected leaders within their own group. One may note from Figure 1 that the various leader selections form patterns, which are indicative of the systems, or networks, of relationships present.[2]

Each such network apparently had its own informal leaders. Families A, B, and C were the leaders of the non-church affiliated group. These three families were interested in economic and production activities, and were termed "big farmers" in the neighborhood. Family E was selected most often as the leader of the closely affiliated church families. Family E, a leader among the youth of the church, was largely interested in programs of a more aesthetic kind.

Family D was located three miles outside the neighborhood, but was selected by three families within the neighborhood. Family D was a cooperator with the district, and was also termed a "big farmer." The reader should note that Families A, B, C, and D, the "big farmers" and all associated with the district, form a network of relationships of their own. This is indicated by the mutual selections of each other as leader families.

HUMAN RELATIONSHIPS NEED TO BE UNDERSTOOD

For one to consider working with Hallers Corners as a neighborhood group in soil and water conservation, it would be well to recognize the following:

1. There were two networks of human relationships in the neighborhood and each had its own informal leaders.
2. The leaders have certain cultural, economic, and ideological differences. Conservation would not mean the same to all of them.
3. The conservationist might recognize two groups for conservation planning in Hallers Corners. His knowledge of the two networks could then be put to effective use.
4. The conservationist, working with the neighborhood as a whole, would want to consider the possibility of pulling the two networks of relationships together for real cooperation. The encouragement of Family B as a key family might accomplish this purpose. Family B is well selected as a leader and is moderately affiliated with the local church; it is young, active, and because of its age composition should be interested in all phases of rural promotional work.

The foregoing discussion has been presented as one possible experimental design to study systems of human relationships as related to the successful integration of new agricultural practices into the local culture of farm people. The description has made obvious the tedious methodology employed. The experience in this experimental situation, and others, has provided encouragement for methods that are less involved in the expenditure of time.

Livingston County is now serving as a laboratory county for the employment of new methods and techniques in the portrayal of human relationship patterns and the selection and stimulation of the holders of local leadership in soil and water conservation activity. Regional, state, and county workers in the Soil Conservation Service are collaborating with members of the Agricultural Extension Service in testing the impacts of such new methods in everyday operation. Such activities denote two broad objectives: (1) *the testing of varying methods in the selection of leader and relationship patterns for soil conservation group activity;* and (2) *the comparison of procedures in effectively stimulating such local groups and leaders in affecting more conservation on the land.*

[2]For the reader who is statistically inclined, the following note may be of interest. In order to test for significant differences in the leadership selections of the two groups, the chi square (X^2) test was employed. The chi square value for one degree of freedom and for a probability value of .001 is 10.827. This explains that deviations from the expected leadership selections caused by chance variations in sampling would produce a chi square of 10.827 no more than once in one thousand times. The chi square for the leadership selections made by church and non-church (including loosely affiliated) families is 15.9. This chi square is larger than 10.827. Thus the probability is less than .001 that the deviations of the leadership selections in Hallers Corners would have been due to chance. In this manner we may decide that the association between church affiliation and leader selection is significant in Hallers Corners.

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Conservation and a Permanent Agriculture

CHARLES F. BRANNAN

MR. CHARLES F. BRANNAN is Assistant Secretary of Agriculture. Prior to his present position, Mr. Brannan was connected with the Farm Security Administration at Denver, Colorado. He points out in the following paper some of the basic conservation and economic principles upon which this Nation should build a permanent agriculture. The paper also includes an analysis of our current and future food needs and the land available upon which to produce such foods in abundance. To achieve a permanent agriculture, Mr. Brannan further emphasizes the fact that *"there should be prepared for each farm in the Nation a basic conservation plan."*

IF I WERE GOING TO CHOOSE a text around which to build my remarks today, I would use one short sentence from the testimony recently presented by the Department of Agriculture before the Senate and House committees on agriculture. The sentence was this: *"Our land resources are under our feet today."*

Many conservation minded people, including members of your organization, have been hammering away for years at the loss of soil, water, and forest facilities which this country is suffering. That message has slowly sunk into the conscience of the Nation. They have come to realize that we were losing valuable resources which we would someday need; that we couldn't go on forever at our present rate without some day finding ourselves short.

But this statement that our soil resources are under our feet, and the context in which it was used, seem to catch the beginnings of a somewhat new line of thinking about conservation. Perhaps there is nothing new about it to this audience, but if the approach taken by the Department in this testimony is followed in making national policy, I think it may make an important contribution.

Today, I want to talk with you about the program suggestions on conservation which we presented to the Congress, and some of the thinking which is behind these recommendations. As we go into it, I think you will see what I mean.

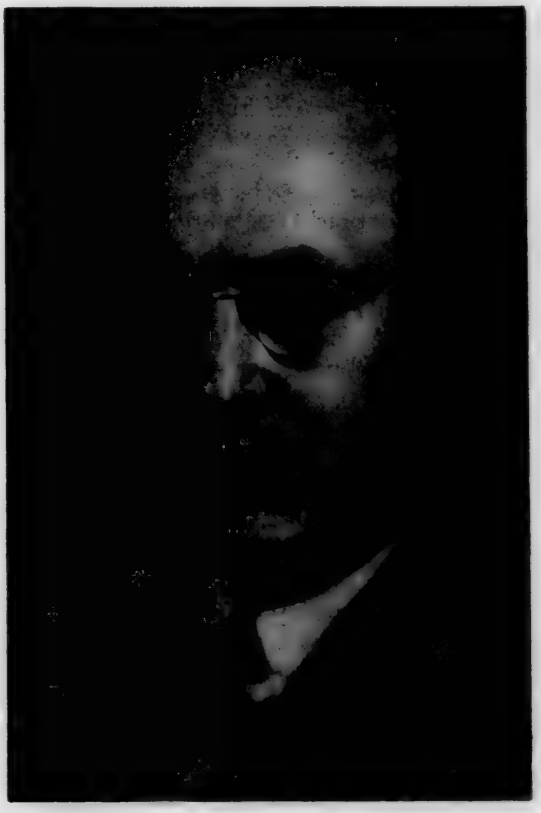
Drain on Resources Heavy

We start with the fact that today half the cropland that farmers are using is subject to erosion in greater or lesser degree, and that the rate of saw timber drain is one and a half times the rate of growth. That is not a pleasant picture to face after all the effort which we have put into conservation in the past decade.

It is important, however, that we keep this problem in its proper perspective. In terms of the length of time erosion has been going on in this country, our conservation program is quite young. We've made a lot of progress in the past decade. We have tried a number of new techniques, and we have learned a lot.

An essential attribute of a great nation is its ability consciously to adjust its policies and programs in light of experience and changing conditions. Certainly things have changed in this country since we began our conservation "action programs" back in the thirties. So we are trying to take stock of where we are and see what changes, if any, are needed for the future.

Today, while the urgency of the world food crisis is uppermost in our minds, there is little disposition to question the desirability of careful over-all planning and direction of our agricultural production effort to meet these needs. But the long-run need is equally great. This is brought home forcibly when it is realized that the food and fiber requirements of our expected population 15 to 20 years hence will be equal to or greater than our present domestic consumption plus the anticipated export requirements under the Marshall Plan.



Charles F. Brannan, Assistant Secretary of Agriculture

These reasons—the diminishing quantity and quality of our land and forests, the growing importance of food in world affairs and the increasing requirements of our own population—all emphasize the need for a national policy and plan for the most effective utilization now and in the future of our limited agricultural resources. We must have a conservation program which will enable us to move as fast as possible toward a permanent agriculture.

ABUNDANCE FOR AMERICAN AGRICULTURE

And by a "permanent agriculture" we mean an organization of agricultural resources—including both land and people—which over the long run will make possible the most efficient production of a sustained abundance of food and fiber products for the consumption and export requirements of the Nation's growing population, while at the same time bring good returns to our farmers.

In the Department's recent testimony at the hearings of the Joint Senate and House Agricultural Committees, we recommended a long-range policy of sustained and realistic abundance for American agriculture. We are convinced that this is the only sensible policy for the country to adopt. It is an essential part of the Nation's full-employment policy. It is also essential to the realization of a basic tenet of our form of government—that of providing the possibilities of a satisfactory standard of living for everyone. We must not purposely set our sights at any lower goal.

In order to measure the adequacy of our resources to furnish such permanent abundance, we had to set up some form of yardstick. We had to have some idea of just what would be required in terms of home consumption, exports, feed, and industrial uses of the various crops. Though the measuring device chosen is at best rough, I think you will find it interesting.

We agreed that for these purposes we might assume that all people of the Nation would like to eat as well as those families having incomes of $2,000 or more at 1941 price levels. Also, it was agreed that we should allow for expected increases in crop yields. But to make sure the figures were conservative, we didn't allow for any increase in population.

What we came out with was a pretty good picture of acreages of various crops needed to feed all our population as well as what those families with incomes over $2,000 a year ate in 1941, allowing conservative amounts for exports and other uses and some increase in yields per acre.

FOOD NEEDS AND AVAILABLE LAND ARE RELATED FACTORS

We have known for some time, of course, that as people's incomes rise they consume more of the high value foods—meats, dairy products, vegetables, and fruits. Our experience during the war and since then emphasized this fact. We know, for instance, that in the twelve months which ended last June 30, American civilians consumed, per capita, nearly one-fifth more than before the war—and most of the increase was in these high value items. But even under the assumed level and pattern of consumption, food consumption would go even higher than that. Per capita consumption of meat would reach 205 pounds—that is 34 pounds more than was consumed per capita in 1946. Milk consumption would equal 1,014 pounds—nearly 200 pounds more than in 1946. Fruit, 327 pounds, which is 95 pounds more than per capita consumption in 1946.

We multiplied the potential per capita consumption estimates derived in this way by 142 million and divided the result by the assumed per acre yields to give us figures of over-all acreage requirements.

Here is the picture. We would need for crop production 415 million acres. This compares with 408 million acres of crop land last year and a pre-war average of around 406 million. We would need a total of roughly 300 million acres for intertilled and close growing crops, which compares with some 306 million acres last year and a pre-war average of about 311 million. Hay and rotation pasture acreage would comprise 115 million acres compared with slightly under 102 million acres last year and about 95 million average pre-war. The indicated reduction of roughly 10 million acres in intertilled and close growing crops and the 20 million acre increase in rotation pasture and hay from pre-war averages, reflect largely the shift in the assumed consumption pattern to more livestock and dairy products.

To complete the picture—we would need some 8 million acres for fruit and nut production compared with less than 6 million both pre-war and last year. We would need to use all of our available farm pasture land—some 576 million acres—and the 375 million acres of other grazing lands which includes both forest and untimbered public and private lands other than in farms, to support the required 76 million, 400 thousand roughage consuming animal units. All of our present area of commercial forest land, 461 million acres, would need to be continued in that use under good management in order to supply our potential requirements for forest products.

This is the picture of the acreages that we will need in various agricultural uses to support a policy of agricultural abundance for our present population of roughly 142 million. But our population is increasing. Some experts have estimated that we will reach a peak popula-

tion of between 160 and 170 million around 1970. This will intensify the demand upon our agricultural resources.

Such is the generalized picture of the kind of agricultural plant we will need under a policy of sustained agricultural abundance. Admittedly, it is at best a rough approximation. It does, however, provide a target at which to shoot. We can always adjust the target to fit changing conditions and our improved knowledge.

Now I would like to compare this concept of what we will need in our agricultural plant with what we now have in the way of land resources.

LAND USE IS A BASIC NEED

First, as to the 415 million acres of cropland, our studies indicate that almost half of this total—some 180 million acres—are subject to impairment and, therefore, to decreasing yields on the basis of their condition and use in 1946. The Soil Conservation Service has estimated that we are presently cropping 61 million acres of steep and eroding lands which should be planted to grass and trees. We are fortunate in that we have some land, perhaps as much as 70 or 80 million acres, which can be converted to crop use by irrigation, drainage and clearing; but the cost of such conversions will be high and may require considerable public assistance.

We have plenty of forest land, if well managed, *ultimately* to grow all the timber products we shall need, with a margin for unavoidable losses, new uses, export and national security. But as of today our forests are not in condition to meet either the immediate or long-run needs. Our studies indicate that in 1944 only 164 million acres out of the 461 million acres of commercial forest land were under any planned management. In that same year the drain of 53.9 billion board feet of saw timber exceeded growth by 18.6 billion board feet. Our long-run needs for saw timber are estimated at between 50 and 72 billion board feet per year. Our present annual growth is only about half as much.

The situation with respect to our range lands is comparable with that of our forests. The 950 million acres should, if managed and used properly, be adequate for our long-run needs. But as of today less than half—some 435 million acres—are in satisfactory condition whereas more than 500 million acres have been impaired as a result of past abuse, present grazing practice and fires.

From this picture of our present situation, it is possible to reach certain broad conclusions. The FIRST major conclusion is that, *despite past misuse, we still have the physical resources with which to build a permanent agricultural plant adequate to meet the needs of our growing population for sustained agricultural abundance.* The SECOND major conclusion is that *if we are to achieve this goal of sustained agricultural abundance, we must as rapidly as possible and within the limits of economic feasibility, apply the necessary measures to stop the further deterioration of our agricultural resources and, restore the productivity of lands damaged by past abuse.*

The THIRD major conclusion is that *as we go forward toward our goal, we must make sure to tie down securely the gains that we make.* Our margin will be too close to permit us to revert to former ways.

BUILDING A PERMANENT AGRICULTURE

Now let's turn to the steps that will be necessary in moving toward a permanent agriculture. We are convinced that the job is so big and so complex that it will require the best efforts of everyone in position to help. The major burden, however, will fall inevitably on the people on the land operating as individuals and in close association with their neighbors. This is as it should be under our precepts of government. But we must not expect the individual to carry the whole load by himself. In conducting his activities, the individual will of necessity generally favor actions which yield immediate benefits over those from which the benefits will be long delayed. Too often he is limited in what he can do by financial considerations. Or the solution to his problem may extend far beyond the boundaries of his own property.

But the public has a stake in this problem too. The public's vital concern in the long-run and over-all aspects of conservation justify and require that government—local, State and Federal—extend every reasonable aid to the individual in helping him to take the necessary actions and make the necessary adjustments in the use of his land.

In the Department of Agriculture we have been studying ways and means for strengthening our conservation program and in our long range testimony we made several specific suggestions on this subject. There is need for a closer integration of our efforts in the fields of production and conservation. For instance, we know that agricultural production needs to be in balance with market outlets and with efforts on the market side to achieve desirable nutrition aims. The most powerful incentive to achieve desirable production adjustments is to make these adjustments profitable for individual farmers. I have indicated how meat, milk, fruits and vegetables have definite possibilities of market expansion, if they can be sold at prices proportionate to consumer purchasing power. Expansion of these products would promote the objective of improved diets. And the shift toward more meat and milk would mean more land in soil conserving hay and pasture use.

A CONSERVATION PLAN FOR EACH FARM

In the second place, *we believe that as rapidly as possible there should be prepared for each farm in the Nation a basic conservation plan.* This plan would consist of an inventory of physical land conditions and a determination of the several practices which will meet the requirements for safe land use and provide the basis for a fully developed farm operation. Our present thinking is that this plan could well provide the basis for all conservation activities of any or each of the agencies of the Department and a common foundation for the work of all the Federal and cooperating State agencies in the conservation field.

The development of new areas of cropland out of the some 80 million acres suitable for this purpose needs to be coordinated and integrated with the whole effort to improve our national farm plant. If properly handled, it will greatly facilitate the shift of steep and eroding lands to less intensive uses. In the West, where water is the critical resource, we must make certain that irrigation developments make their maximum contribution to the over-all objectives.

So far I have largely confined my remarks to the agricultural aspects of the long range policy of sustained agricultural abundance. I must not leave the impression, however, that such a policy can stand alone without regard to the close ties that bind our agricultural economy to the national economy as a whole. The President's recent message to the special session of Congress recognized this interdependence in the following words:

"Our long range programs must stress ever-increasing production.

"To accomplish this for agriculture, we need a comprehensive farm program. We shall need programs to increase the use of farm products by industry and consumers in this country when other countries become more nearly self-sufficient. Long range national measures will be needed to protect the farm population against ruinous deflation in farm production and prices.

"To expand industrial output we need a long range program to overcome basic shortages in capacity and equipment. To provide markets for increased output of farm and factory, we shall need long range programs to raise the standard of living, particularly for families of low income."

Yes, above all else we must be realists.

OTHER PROBLEMS CONCERN AGRICULTURE

We know that business and industrial activity depends upon many factors and that even under a policy of full employment the curve showing the condition of the economy over a considerable period is bound to have some peaks and valleys. What are we going to do when the economy of the country heads down into one of these valleys and people find their food dollars running short? Should we permit surpluses to pile up and prices to the farmer to slide down until they descend below the cost of production? Shall we allow food to be wasted—burned—to go unharvested while millions of people become victims of malnutrition? That is not in keeping with a policy of sustained agricultural abundance.

The Department's testimony presented to the Joint Congressional Committees on Agriculture presented specific recommendations for meeting this situation. We recommended a floor under food consumption through expansion of the school lunch program and direct distribution programs and the adoption of a food allotment plan if and as such programs may be needed. We recommend, further, keeping the machinery whereby farmers can adjust their production pattern to the demand pattern. Finally, we recommended price supports and modernization of parity so that the farmer in times that are economically slack will not fall victim to ruinous prices but will be aided in his efforts to feed our people abundantly.

While these problems must concern each of us who has the welfare of our Nation and of our agriculture at heart, I find it particularly gratifying to discuss them with a group of soil conservationists. A permanent agriculture and sustained agricultural abundance have been the goals of the soil conservation movement from its inception.

There is today a growing appreciation throughout the Nation of the necessity for, and the value of, development and conservation of all our natural resources. Accompanying this awareness is the widespread recognition of the advantages of comprehensive multiple-purpose plans for resource development and a rapidly spreading idea that such development should be by river basins or regions. The evolution of this idea is already under way. It has begun with river basin programs primarily concerned with flood control, navigation, irrigation and water power. But attempts to confine these regional programs to water have only served to emphasize the inseparability of land and water activities. Gradually, therefore, the agricultural agencies of the Nation are finding it necessary to broaden their programs.

CONSERVATION AND ABUNDANCE ARE INTERDEPENDENT

In summary; the position taken by the Department of Agriculture in its long-range testimony is this: The "some day" when we have predicted that this Nation will have no more soil and timber resources which we can exploit without endangering our standard of living is no longer some time in the future. That "some day" is

(*Continued on page* 36)

A Symposium — — —

WATERSHED MANAGEMENT IN RELATIONSHIP TO WATER RUNOFF AND SILTATION

The symposium that follows: "Watershed Management in Relationship to Water Runoff and Siltation," was presented at the annual meeting of the Soil Conservation Society of America, Omaha, Nebraska, December 5, 1947. Mr. E. J. Utz of the Bureau of Reclamation presided and directed the excellent discussion that followed the four papers.

The theme of the symposium is timely because of the widespread interest in watershed development programs. Each paper brings to light many facts that concern damages caused by floods, the siltation of streams and reservoirs, and the damage to bottomland and irrigation ditches. The symposium also tells how conservation farming, forest and range management, and retarding and impounding structures can reduce the runoff of water and siltation on a watershed basis.—Editor.

Damages Resulting From Uncontrolled Runoff and Sedimentation

CARL B. BROWN

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DEFORESTATION, OVERGRAZING, BAD cropping practices, and other forms of watershed mismanagement have increased floodwater and sedimentation damages; and have caused impairment of surface and groundwater supplies. The effects of floodwaters are well known. We need not give much time to them. The quantitative effect of land use on surface and groundwater supplies is still largely unmeasured. In the short time available we shall have to pass over this problem. The magnitude of sediment damages resulting from soil erosion and watershed deterioration is just beginning to be recognized. Because it is of particular significance here in the Missouri River Basin, it seems appropriate to emphasize it in this discussion.

Considering the widespread publicity that floods receive, it is surprisingly difficult to get any agreement on the average annual flood damage in the United States. According to the Weather Bureau—official flood-reporting agency—the average annual flood loss was $100,657,000 during the 20-year period 1925-1944, inclusive. Various authorities, however, question the completeness of the data on which this figure is based. There is considerable evidence that the flood-damage data do not include —especially in earlier years—the large aggregate damage from frequent, small or local floods in headwater areas.

Flood Damages on Agricultural Lands Heavy

Howard L. Cook published (2) an analysis of the location of flood damages based on flood-control surveys of the U. S. Department of Agriculture. He concluded that 15 percent of the damages occurred in urban areas, generally far downstream; 6 percent were agricultural damages along the main stream; 4 percent were agricultural damages along principal tributaries; whereas 75 percent of the total were damages—mainly agricultural—in headwater valleys. Cook pointed out that nearly all agricultural damages in headwater areas are caused by small, frequent floods. There is serious question as to whether much of these flood damages have ever been included in official figures.

The U. S. Forest Service has made an analysis from flood-control surveys of the U. S. Department of Agriculture which indicates that the total of flood and sediment damages amounts to at least $250,000,000 annually.

Being here at Omaha, it seems appropriate to mention the agricultural and land damages in the lower Missouri River Basin that resulted from the flood-producing storms of May and June, 1947. On the basis of field surveys, the Soil Conservation Service has estimated that crop losses on overflowed bottomlands amounted to $40,000,000; crop losses from rain, wind, and runoff on uplands amounted to $137,000,000; land damage by stream-bank cutting and major gully development was $4,000,000; damage to bottomlands by flood-plain scour and sediment deposits was $134,000,000; and land dam-

age to uplands by sheet erosion, on the basis of $1.00 per ton of soil lost from tillable land, was $404,000,000. The grand total of these damages is nearly $720,000,000.

In addition, there was a large amount of non-agricultural damages to cities, roads, drainage enterprises, reservoirs, etc., on which figures are not yet available.

It has seemed desirable for some purposes to try to segregate sediment damages from flood damages. Our efforts in this direction have led to a figure of $175,000,000 as the annual value of sediment damages. Actually, flood damages, as usually collected, include some forms of sediment damage. Furthermore, most sediment damages, even such items as reservoir silting, are caused mainly by flood flows.

After considering all of the possible overlaps and omissions in the collection and analysis of damage data, it appears that floodwater and sediment damages combined, but not including losses from upland soil erosion, may average $300,000,000 or more annually. Of this amount, somewhat more than half may be classed as sediment damages, including associated land damage by floodwater scouring and stream-bank erosion.

SEDIMENT DAMAGE IS CUMULATIVE

Floods are spectacular. Like plane crashes or train wrecks, they make banner headlines. They are recurrent. They come today and are gone tomorrow. Every year they strike somewhere or other. The trail of damage they leave is plain for everyone to see, and those affected demand remedial action. By contrast, most sediment damage is cumulative. We are often not aware of it—in the absence of special surveys—until it has caused almost complete ruin.

Consider, for example, our huge multiple-purpose reservoirs. Lake Mead, created by Hoover Dam on the Colorado River, is a good example. The dam and all the developments dependent on it, when ultimately completed, will cost more than a half billion dollars. One of the nation's prominent engineers, J. C. Stevens estimated in 1945 (5) that Lake Mead would be completely filled with sediment in 144 years (by 2080 A.D.) and would be seriously impaired by the time its active storage is half filled (2002 A.D.) in the absence of upstream developments. The damage to this one reservoir amounts to several million dollars annually.

Or again, consider the situation here in the Missouri River Basin. The Pick-Sloan plan for comprehensive development of the water resources of the basin includes more than 100 reservoirs impounding an estimated 63,000,000 acre-feet of water. On top of this is Fort Peck Reservoir, already constructed, with a capacity of 19,400,000 acre-feet, plus some 10,000,000 acre-feet more of developed storage in reservoirs larger than 5,000 acre-feet scattered throughout the basin. Thus the grand total of contemplated and existing storage is nearly 93,000,000 acre-feet.

Existing data indicate that the Missouri River at Kansas City transports not less than 125,000 acre-feet of sediment annually. But, considering the sources and distribution of sediment supply within the basin, and other technical factors, there is considerable evidence that storage loss from silting, when all reservoirs are constructed, may be at an annual rate of 200,000 acre-feet or more. In other words, we may expect one million acre-feet of storage to be lost every five years. The average cost, at present prices, of the reservoirs proposed in the Pick-Sloan plan will be at least $10 per acre-foot of storage. If we evaluated this storage loss as a straight-line depreciation of investment, the cost of silting would be not less than $2,000,000 annually. Actually, the cost of the reservoirs represents only a minor fraction of the value of the developments which will depend on these reservoirs. Hence, the true dollar loss from silting may be 5 or 10 times as much as that indicated by simply charging off the storage loss at the cost of its development.

If this storage loss in the Missouri Basin occurred at the same rate in all reservoirs, which of course it will not, all the storage would be lost in less than 500 years. A long time, surely, to us—as individuals—but not a great span of years in the life of a nation when we recollect that existing irrigation developments in China and Egypt have covered a span of 10 to 30 centuries.

We estimate that the current annual silting damage to the Nation's 10,000 existing storage reservoirs is in the order of $50,000,000. This damage is, of course, rising constantly with the increasing tempo of reservoir construction.

SEDIMENTATION IN RESERVOIRS COSTLY

The number of people affected by sediment is surprisingly large. For example, nearly 35,000,000 persons use annually some 1,400 billion gallons of surface water that has to be filtered to remove fine sediment, which is largely a product of soil erosion. Many of these people also depend on surface reservoirs that are being filled with sediment. Thus in the sphere of public water supply alone, more people are affected by sediment than live on all the farms in the United States. These urban residents and industries are paying directly or indirectly, generally through higher water bills, for the sediment washed from fields and ranges and subsequently deposited in their reservoirs or filtered from their water.

The situation at Decatur, Illinois, is an excellent example of the effects of erosion on public water supply out here in the Corn Belt. (1) Decatur has a water-supply

reservoir on the Sangamon River at the edge of the city. From the time the reservoir was built in 1922 until 1936, the reservoir lost 1.0 percent of its capacity annually. Since that date the average loss has increased 20 percent. Allowing for the increasing rate of consumption, the reservoir should have served every need of the city until the year 2000. As it is, the city faces a potential water shortage, should a severe drought occur, in just nine more years—in 1956. The premature replacement of storage lost because of silting will represent an accumulated cost to the city of more than $27,000 annually since the lake was formed in 1922. Other serious losses to recreation and ultimately to property values around the lake are in prospect. Ultimately the total annual damage will probably be valued at $100,000 or more. If this had been an annual flood damage, which made the headlines, remedial measures would have been taken long ago.

Damage to land resources by flood-borne sediment and associated scour of flood-plain soils and stream banks accounts for another $50,000,000 annual loss. Data obtained in flood-control surveys by the U. S. Department of Agriculture on 33 widely scattered watersheds showed that this type of land damage averaged $11.60 per square mile annually on 217,000 square miles. A similar estimate of stream-bank erosion in 20 watersheds showed an average loss of $1.76 per square mile for 130,000 square miles.

The extent and severity of bottomland damage in many parts of the country has been shown by studies in the South Carolina Piedmont. (4) In this section, the bottomlands comprise about 6 percent of the total land area. The modern sediment deposits on the bottomlands average about 4 feet thick throughout this large area. This is equivalent to a loss of 3.1 inches of soil over the entire remaining 94 percent, or upland part, of the area—a loss which has occurred in an average period of about 150 years. About 20 percent of the 400,000 acres of bottomland is now used for crops. About 10 percent more is used as open pasture in various stages of improvement. This leaves 70 percent, or 280,000 acres in scrub woodland or wild pasture. At least 180,000 acres of this land would be suitable for intensive agriculture if it could be protected against present excessive floods and sediment damages.

INVESTMENT IN DRAINAGE AND IRRIGATION ENTERPRISES HEAVY

Drainage is one of the major types of capital improvements in agriculture. To 1940, more than $690,000,000 had been invested in drainage enterprises. More than one-half of this amount was spent in the construction of open ditches. We estimate that the damage from sediment to drainage enterprises amounts to 20c per acre for the 86 million acres in such enterprises—or a total of $17,000,000 annually. This is an estimate of the actual cost of cleaning ditches or the costs that would be necessary if ditches were properly maintained. A large share of this cost is for the removal of sediment coming from eroding uplands.

As of 1940, slightly more than $1,000,000,000 had been invested in irrigation enterprises in the 17 Western States, and the area that could be irrigated by the then-existing works comprised slightly more than 28,000,000 acres. The annual cost of maintenance and operation of irrigation enterprises, as reported in the 1940 census, was a little more than $43,000,000. We estimate that at least $10,000,000 of this cost may be attributed to removal of sediment or to capital losses suffered from deterioration of the ditches as a result of sedimentation. For example, a survey of irrigation ditches in the Sevier River watershed, Utah, showed that the cost of cleaning 1,430 miles of laterals was $19,900 annually in excess of the cost that would have prevailed if the water coming into these ditches had been free of sediment.

Maintenance of navigable channels in rivers and harbors is a large item of expense to the Federal Government. In the last pre-war year, 1941, we estimate that the Corps of Engineers spent more than $11,000,000 to remove sediment that originated in stream-bank and soil erosion. The volume of sediment dredged was two-thirds as great as the volume of earth excavated in constructing the Panama Canal. Consider, for example, the case of maintenance of the Baltimore, Maryland, Harbor. (3) During the past 100 years, the Federal Government alone has dredged more than 111,000,000 cubic yards of sediment from this harbor at a cost of nearly $17,000,000. In addition, the city of Baltimore and private interests have spent large amounts for channel improvements and maintenance. The average cost of dredging the harbor before the war was about $150,000 per year, and the current sediment inflow is estimated at about 600,000 cubic yards annually. The drainage area above Baltimore Harbor contains only 288,000 acres. In other words, the Federal Government is spending an average of about 50c an acre per year to dredge from Baltimore Harbor the products of erosion on this watershed.

If time permitted, we could go through a recital of many other examples of flood and sediment damages that are attributable mainly to watershed deterioration. I believe, however, that these few statistics and examples will provide something of a setting to the more important discussions to follow on what we can expect from proper watershed management toward the solution of these critical problems.

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Reducing Runoff and Siltation Through Forest and Range Management

REED W. BAILEY

Reed W. Bailey is Director of the Intermountain Forest Service Experiment Station, Ogden, Utah. Mr. Bailey discusses the several aspects of watershed management insofar as they are related to forest and range lands. The paper also contains a brief description of the Wasatch Research Center.

FOREST AND RANGE MANAGEMENT can make a significant contribution toward the solution of many of the flood and sedimentation problems in this country. There are two aspects to this contribution. One is the possibility of reducing peakflow discharges and sediment loads. The other is the prevention of potentially great increases in runoff and siltation rates.

The hydrologic effects of forest and range management are not susceptible of so precise evaluation as are such projects as levees, dams and reservoirs. Wildland management embraces the application of many measures such as fire control, cultural treatments, road construction and installation of small mechanical structures in addition to systems of harvesting timber and forage. These are applied over extensive and frequently varied areas. These land treatments, with the possible exception of some types of mechanical structures, do not produce fixed changes in runoff and erosion characteristics. Instead, they set in motion processes of plant succession and soil development which may require long periods of time to become fully effective.

Notwithstanding these obstacles to precise evaluation of the effects of forest and range management on runoff and siltation, there is a sound technical basis for watershed management. This basis rests in the results of carefully controlled experiments on both plots and entire watersheds. A recitation of the results of all these investigations is beyond the scope of this paper. Out of these research efforts, however, have come major principles and concepts of the role forest and range management can play in the control of runoff and siltation. These principles and concepts are herein discussed as they apply to several distinctly different types of water runoff problems.

Watershed Management

Watershed management differs but little from forest and range management, except in objectives. The primary objectives of forest and range management are maximum sustained yields of highest quality timber and forage, whereas the objective of watershed management is the production of maximum quantities of usable water. This generally means minimum peak discharges, a better sustained flow and maximum stability of soil on slopes and of materials that make up the valley fills.

Every forest and range site, in addition to producing living things and developing a soil mantle, performs the functions of receiving and disposing of precipitation, the end products of which are runoff and the sediment load of streams. All the elements of management, including protection, utilization or manipulation of the forest or range cover and soil mantle, have an important bearing on the hydrologic behavior of the land.

Removal of plant cover alone causes a number of changes in the reception and disposition of precipitation. Plant cover removal, by reducing interception, increases the amount of precipitation that reaches the ground and bares the soil to greater impact of the weather. It speeds up snow-melting and also increases the depth, tightness and duration of frozen soil. It usually decreases transpiration losses, especially when streambank vegetation is removed. These effects all tend to increase rates of runoff and erosion.

The compaction of soil and the decrease of litter and organic matter in the soil which generally attend the improper harvesting of timber, the overgrazing of forage, and the building of roads also have important hydrologic effects. Chief of these are reductions in the infiltration and storage capacities of the mantle and a consequent increase in overland flow and erosion. These tendencies toward increased rates of runoff and accelerated erosion are a major problem in land management.

The soil mantle on the forest and range lands of the Nation constitutes a vast reservoir for storage and detention of runoff when kept intact. This mantle, however, is also a potential source of greatly increased runoff and of enormous quantities of sediment if its hydrologic functions and the stability of the soil are impaired. Correction and prevention of watershed impairment is possible under properly designed management of the land resources. There are important limitations, however, to the extent that good forest and range management can lessen the sediment that is and will be carried by the streams.

RUNOFF CONTROL AND PREVENTION POSSIBILITIES

Every forest and range site, as well as every watershed, is the product of many natural processes, including rock weathering, soil formation, erosion, and biotic succession, all of which have been operating under the impact of climate over the ages. Because of local differences in the climate, the resistance of rock to weathering, and such other features as the aspect, length, and steepness of slopes, differences have developed in the character of the plant cover and soil mantle, and in runoff and in the sediment load of streams. In some drainage basins, streams fluctuate but little either seasonally or annually, and carry negligible quantities of sediment. Others are frequently in violent flood stage and are generally muddy. Still others exhibit runoff and siltation characteristics between these extremes. Where such variations are but manifestations of different degrees of control established by nature, there is little that watershed management can do toward their control.

It is pretty well established, however, that many of the floods and much of the sediment load carried by streams are not of normal proportions, but have been magnified by impairment of the plant cover and soil mantle on the watershed slopes and in valley bottoms. Watershed management can reduce such discharges and siltation rates, but only to the extent they have been increased by watershed deterioration above the normal. Watershed management can also prevent potentially great increases in runoff and erosion rates above the normal. The extent to which these protection and prevention controls can be exerted is indicated in the results of studies of typical runoff and erosion situations in various parts of the country.

FLOODS IN THE HUMID EAST

We are all aware of the seriousness of the flood and sedimentation problems in the Mississippi, Missouri, Ohio and other drainage basins of the so-called humid area east of the 100th Meridian. Those who are faced with the job of controlling these floods and sediment loads are also interested in the extent to which those objectives can be accomplished by management of the wildlands.

Floods are a normal occurrence in the rivers of the humid region because rains occur from time to time that are of greater volume than the storage capacity of the watershed mantle. It is also normal for these streams to carry various amounts of sediment, especially in flood stage. There is no question, however, but what greater floods and especially larger sediment loads are now being experienced. It is readily understood why this is when we realize that a large segment of the original forested area has been cleared for agriculture and that other large areas once farmed have been abandoned, and that still others have been repeatedly burned and destructively logged. These changes unquestionably have accelerated runoff and erosion. This is borne out by numerous measurements on experimental watersheds and plots.

For example, at the time of the disastrous flood of the Yazoo River in 1931-32, when 27 inches of rain fell, 62 percent ran off cultivated fields immediately and carried soil with it at the rate of 34 tons per acre. On barren abondoned fields the runoff was 54 percent of the total rainfall. During the heaviest rains from 75 to 95 percent of the rain falling on these classes of land became surface runoff. On the other hand, of the 27 inches of rain falling on an undisturbed oak forest, less than 0.5 percent ran off the surface, taking only about 75 pounds of soil an acre. Runoff from a plot located in a scrub oak forest with a litter cover was only 2 percent of the rainfall. In short, the surface runoff from land in cultivation was 127 times greater than from forest land, for the period of observation, and the amount of soil carried off was over 900 times greater. Similar results have been obtained in many parts of the country.

Reforestation of cutover, burned, and abandoned farm lands, with resultant restoration of the infiltration and storage capacity, and stability of the soil mantle will greatly reduce the contribution of sediments to streams and will also substantially lessen the peaks of many floods. Quantitative effects can be evaluated only by careful consideration of each subbasin.

SNOWMELT FLOODS IN THE WEST

One of the most common types of flooding in the West is the high discharge which occurs annually in the spring during the melting of snow. Some of these floods originate on low elevation foothill and valley lands where it is not uncommon for snowmelting to be hastened by the occurrence of warm rains. Most of the large and prolonged discharges, however, originate at high elevations where the snow is deep and where melting temperatures prevail for only a few hours each day. At these high, cool elevations, water is generally released from the snow at a rate that is slower than the infiltration capacity of the soil mantle. The floods therefore generally develop as ground water discharges rather than as overland flow, after the mantle becomes charged to its full retention-storage capacity.

These floods vary widely in magnitude by reason of normal fluctuations in the amount of snow, the rate of snowmelting, and the storage capacity of the watershed mantle. These discharges can be affected, however, by alteration of the plant cover.

A classic test of this influence was made at Wagon

Wheel Gap in Colorado some 20 years ago. Here, the forest cover was cut and burned on one watershed and left untouched in a paired basin. As a consequence, peakflows from snowmelt from the treated basin during the next few years exceeded those of the untreated basin by about 25 percent, the extremes ranging up to about 50 percent. Differences in peak discharge between the basins lessened each year after the first two years because of the recovery of the vegetation and by the seventh or eighth year, there was but little difference.

The treatment used in this experiment was not representative of extreme plant cover depletion. Moreover, these watersheds were not subjected to high intensity rainfall during the period of the test. The results, however, are indicative of the extent to which snowmelt discharges can be increased by removal of the forest cover by clear cutting. They also show that essentially normal runoff control can be restored in similar areas by natural revegetation in a period of about 10 years.

PROLONGED WESTERN RAIN FLOODS

A notably different type of flood in the West is the discharge caused by abundant rainfall. High discharges from such rains are of annual occurrence in parts of the Pacific Northwest and on the mountains of southern California, and these frequently reach flood proportions. Like the snowmelt floods, they occur because more rain falls in a given period than can be stored in the watershed mantle.

Watershed management can play an important role in the lessening of these floods as has been demonstrated many times in southern California. There, depletion of the plant cover by fire has resulted in flood peaks which have ranged up to 17 times the magnitude of discharges from unburned watersheds. The differences in the amount of soil removed from burned and unburned areas are much greater. Measurements show that whereas unburned areas lost as little as 1.2 cubic yards of sediment per square mile, burned but otherwise comparable areas lost up to 74,830 cubic yards of material or some 60,000 times more.

The restoration of the original control exercised by the chaparral cover following fire on the watersheds of southern California is a much slower process than the recovery of most forest lands. Studies in that region show that substantial recovery is possible in a period of about 10 years where maximum rates of natural revegetation are made possible by complete protection from fire. However, control approaching normal requires a period of protection from fire that is more nearly in the magnitude of 50 years.

SUMMER "CLOUDBURST" FLOODS

Another type of flood that is common in the West is the so-called "cloudburst," or high intensity summer rain, flood. This type of flood differs radically from snowmelt and abundant rainfall floods with respect to both the hydrologic processes involved and the possibilities of control by watershed management.

Summer cloudburst floods are discharges of runoff that originate mainly as overland flow. Saturated mantle conditions are not necessary for their generation. In the Intermountain and Southwestern portions of the West, especially, such floods usually occur, in fact, when the mantle is relatively dry and has a capacity for storing many inches of rainfall. The critical reason for the occurrence of such floods is that rain falls at rates which are faster than the water can get into the mantle.

There are two other aspects of cloudburst floods which have an important bearing on possibilities of control by watershed management. One of these is the relatively small volume of rainfall involved and the other is the small runoff area. It is known, for example, that a destructive summer flood capable of carrying boulders nine feet long from the mouth of a 2,000 acre watershed in northern Utah was generated by less than one-half inch of rainfall. It is also known that this same flood and numerous others in nearby watersheds were caused by runoff from less than 10 percent of the watershed lands.

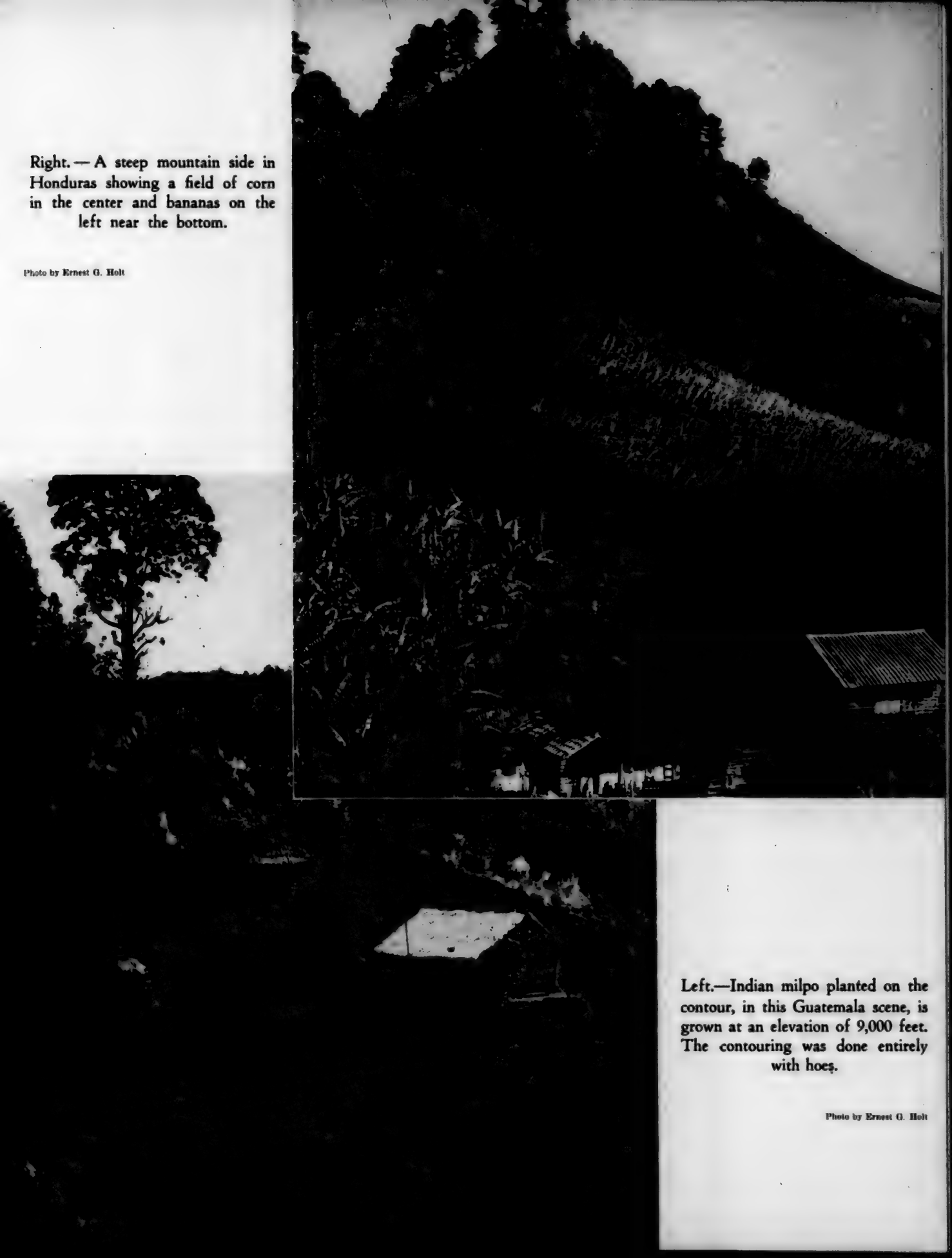
Summer cloudburst floods are as natural a phenomenon in the West as are great discharges caused by melting snow and prolonged rains. Such floods, however, are normal only in watersheds which have a naturally low infiltrating capacity. Bryce Canyon in southern Utah is typical of watersheds which have a normally high incidence of flooding and of sediment production. However, all of the West is not arid and barren. There are many mountain watersheds where a sufficiently dense plant cover and deep soil mantle has developed that is capable of handling the greatest intensities of rainfall normal to the area without producing excessive quantities of overland flow or losses of soil. These areas, however, are capable of producing debris-laden discharges of great magnitude when the plant cover is depleted.

CONTROL OF POTENTIAL SUMMER DEBRIS-FLOODS

The flood of August 19, 1945, in Salt Lake City is illustrative of the tremendous potentials which can be unleashed by destruction of the plant cover. A fire burned over 600 acres of a 1,000 acre foothill watershed immediately north of the city in the summer of 1944. A high intensity rainstorm struck this area in 1945. There was no evidence of runoff or soil loss on the unburned portion of this basin. Runoff from the burned portion, however, removed up to several inches of soil in many

Right. — A steep mountain side in Honduras showing a field of corn in the center and bananas on the left near the bottom.

Photo by Ernest G. Holt



Left.—Indian milpo planted on the contour, in this Guatemala scene, is grown at an elevation of 9,000 feet. The contouring was done entirely with hoes.

Photo by Ernest G. Holt

Left.—This picture, t
the Hayden Expediti
Laramie River Valley,
ty, Wyoming. Pioneer
settled on this new
build their homes and

Right.—Conservatio
this 344-acre Ohio fi
a new landscape patte
neer land movement
need to conserve soil
vide food, clothing a
keep our country stro

Right.—Virgin forests are few in number. This fine virgin stand of hemlock and beech in Pennsylvania is a reminder of pioneer days. Forest conservation may not bring back scenes of long ago, but wooded areas, when protected and managed, will produce the timber needs of a growing nation.

Photo by W. R. Van Dersal

aken in 1870, shows
ion camping in the
, now Albany Coun-
rs, shortly thereafter,
productive land to
l a new country.

Photo by W. H. Jackson

farming, as seen on
m, has brought forth
ern. It too, is a pio-
and is based on the
and water and pro-
and shelter; also to
ong and productive.

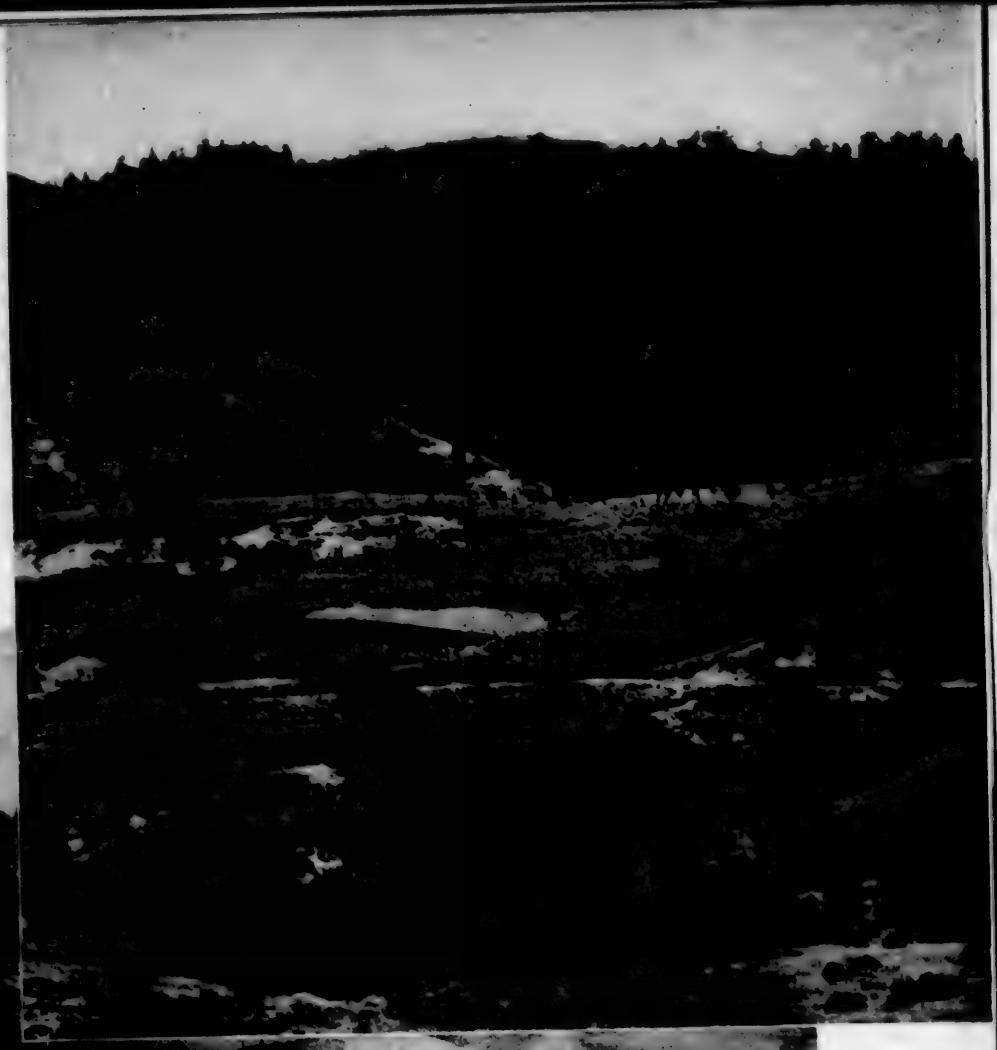
Photo by H. W. Black

Left. — A mountain valley farm near Elkins, West Virginia. Conservation practices planned and established according to the capability of the land has anchored the soil and materially increased the farm income. The community standards have also been improved and strengthened.

Photo by H. G. Postlethwaite

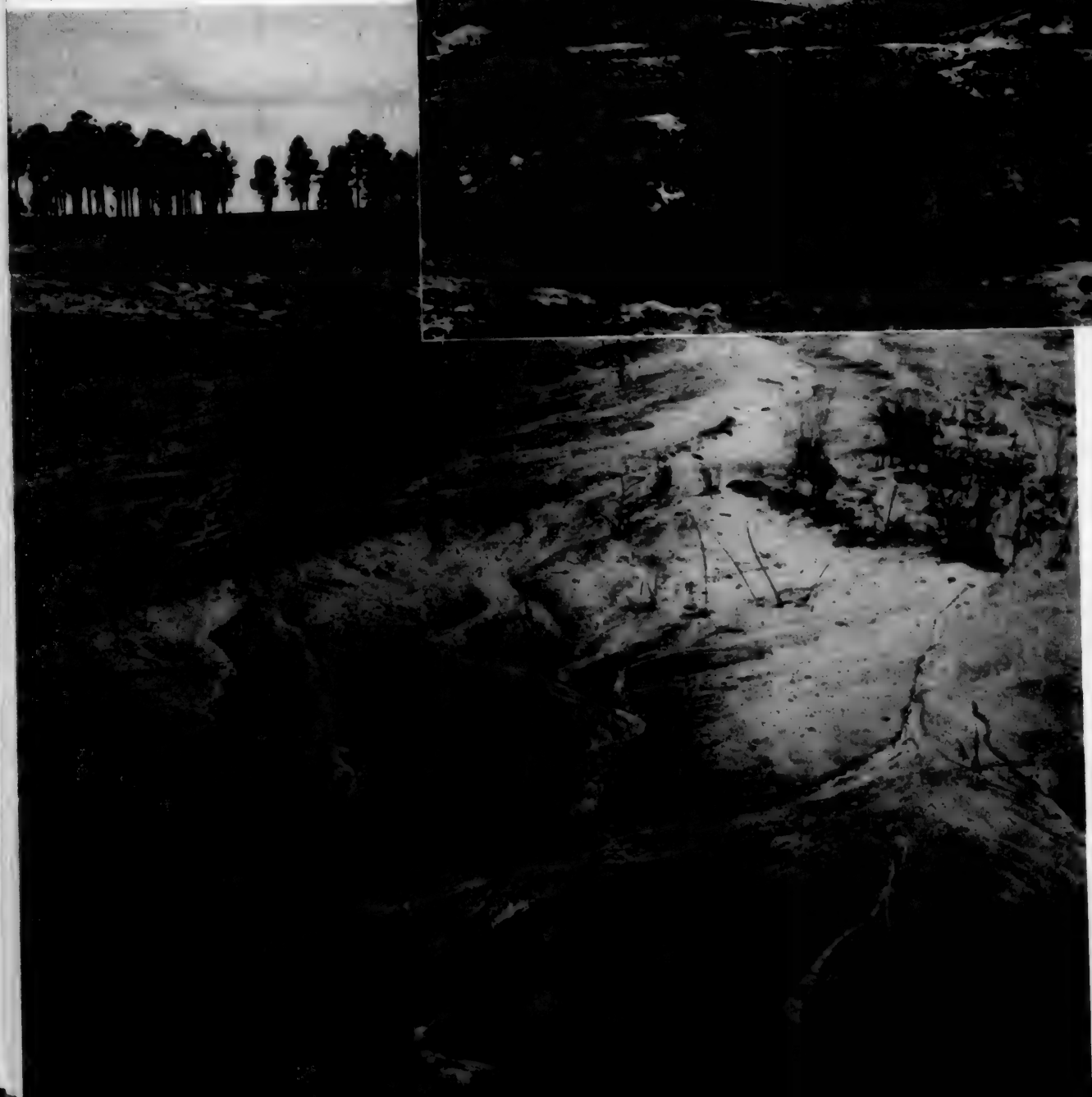
Right.—This scene in Guatemala shows an open range at 9,600 feet elevation. Overgrazing by sheep is causing the land to break and wash away.

Photo by Ernest G. Holt



Below.—The productive capacity of this land located in Tift County, Georgia, is gradually being depleted. It will be unfit for cultivation within a few years unless sound conservation practices are applied on the land.

Photo by John W. Busch



places. It also developed a peakflow discharge which has been estimated to be about 300 times greater than the measured peak discharges from nearby unburned watersheds on which rainfall is known to have exceeded previously recorded maximum intensities.

Fire is not the only agent which can break the normal control of summer storm runoff. Overgrazing, though usually requiring a longer period, can accomplish the same results, as has been demonstrated on a number of experimental watersheds and plots in various parts of the West.

Because of the small amounts of rainfall and the relative smallness of the flood-source areas, summer cloudburst floods are highly susceptible to control by watershed management wherever such floods and erosion have been induced by deterioration of the plant cover. The extent of such control has been demonstrated on watersheds at the Wasatch Research Center in northern Utah. Here, destructive mud-rock floods were brought on by destruction of the plant cover on less than 10 percent of the watershed lands. The infiltration and storage capacity of these sites was reestablished by the construction of contour trenches, artificial reseeding, and by protecting the lands from overgrazing and fire. Since 1936 these watersheds have been subjected to a number of high intensity storms, some of greater intensity than ever before recorded in Utah. On several occasions, notably in 1936, in 1945 and again in 1947, mud-rock floods have reissued from nearby watersheds on which improvement measures were not applied or completed to adequate standards. On the more carefully controlled experimental watersheds, there have been no floods.

Watershed Management Limitations

A high degree of runoff and sediment control was possible on these experimental watersheds because the improvement measures restored essentially the same watershed conditions that existed prior to their deterioration. This is the maximum degree of control that can be expected anywhere from watershed management.

The achievement of effective control of runoff and siltation is subject to two other important limitations. For one thing, watershed slope treatments alone cannot be expected to effect prompt or substantial reductions in sediment loads where large quantities of material are already on the move in channels. It must also be recognized that restoration of depleted forest or range cover is at best a slow process and that improvement of soil is even slower. It may require many years, therefore, for watershed management to become fully effective in controlling runoff and siltation within limits that are normal for each basin. Where substantial quantities of soil have been lost, such a degree of control may be impossible for many generations.

Dams and levees though necessary for flood control in many basins, will not affect the reception and disposition of precipitation on the land nor will they keep soil in place on watershed slopes. This is in the field of watershed management. Proper management of the soil and plant cover can maintain the stability of soils as well as effect substantial reductions in discharges and therefore is an essential part of any comprehensive program of runoff and siltation control in all drainage basins.

In the several examples cited of the extent to which forest and range management can reduce runoff and siltation, emphasis has been placed on the normal limits involved rather than quantitative effects. This was done because quantitative measurements are of absolute value only on the area from which they are obtained. Many more such measurements are needed for evaluation purposes. In all cases, however, it is important to realize that all effects of management must be measured from the baseline of what is normal for each site and each watershed.

What Is a Good Seedbed?

A good seedbed is one that when you pick up a handful of soil the fine grain-like granules or aggregates trickle through your fingers. It feels loose and mellow in your hand. It is well supplied with readily available organic matter. It contains enough large pores to allow rapid moisture movement into it during periods of heavy rainfall or allows rapid movement of water into drain tiles. It contains enough air so that the millions of soil micro-organisms are actively decomposing an abundant supply of organic material, making available nutrient materials for the plant. Its granules and aggregates are in small clumps and not in large clods. The granules are stable and resist the beating action of raindrops. It is loose and mellow but not too loose for good germination of the seed. It also has favorable air, water nutrient relationships at a depth favorable for root development.—*From a paper presented by George M. Browning, of Ames, Iowa, before the Annual Meeting of The Soil Conservation Society of America, held in Omaha, Nebraska, December 4, 1947.*

Conservation Farming Reduces Runoff and Siltation

T. B. CHAMBERS

This paper by T. B. Chambers, Head of the Drainage Section of the Soil Conservation Service, Washington, D. C., recognizes the many accepted conservation practices that contribute to the reduction of runoff and siltation. Mr. Chambers has written numerous bulletins and papers pertaining to drainage.

IN CONSIDERING THE INFLUENCE of conservation farming on runoff and siltation it is desirable to consider these phenomena separately in so far as quantitative rates and amounts are concerned. While we recognize the relationship of cause and effect in runoff and siltation there are too many factors involved to permit the derivation of a formula that would indicate units of one in terms of the other. Runoff is responsible for transporting sediment but in order for sediment movement to remain constant for a given rate of runoff on recurring occasions it is necessary for all other conditions to remain constant. Such is never the case. Nature interposes many variables that change this relationship, from year to year, from season to season, and from day to day. We know from historical records and present-day experience that high rates of runoff from protected watersheds may produce clear streams while low rates under unfavorable conditions result in excessive turbidity and heavy siltation. Conservation farming practices are designed to assist nature in changing unfavorable conditions.

We have adequate experimental data to support the statement that surface runoff from a given rate of precipitation may be reduced or retarded by watershed treatment particularly on small watersheds and plots. The difficulty and expense of making correlated measurements of the actual rates and amounts of runoff and sediment movement from larger watersheds has prevented needed work along this line. However, a number of measurements of reservoir silting[1] give valuable information as to the effects of conservation farming in reducing silt movement from watersheds of areas up to several hundred square miles.

Eighty Conservation Practices Recognized

The Soil Conservation Service recognizes over 80 practices as useful in a soil conservation program. All of them have proved to be economical when properly used in accordance with the capabilities of the land and the management plan of the farmers. The effects of some of these have been determined quantitatively on experiment station plots and small watersheds.

The practice of cultivating approximately along the contour of sloping land instead of in straight rows up and down the slopes has been tested in 21 experiments in 11 states, with a large range of crops and slopes during continuous periods of 1 to 11 years.[2] These experiments have shown that contour cultivation reduced soil loss from sheet erosion by 37.6 to 100 percent, with an arithmetic average of 73.6 percent from all the experiments. The reduction in average annual runoff ranged from 12.3 percent to 98.7 percent, with an arithmetical average of 54 percent.

Strip cropping has been tested in 17 experiments in 7 states, with all major crops, slopes and rotations during periods ranging from 1 to 7 years.[3] The reduction in soil loss from strip cropping over that experienced from continuous cultivation of a single crop ranged from 10.7 to 94.1 percent, having an arithmetic average of 59 percent.

The same values are not apparent, however, in reducing runoff. In nine of the experiments the reduction in average annual runoff ranged from .4 of one percent to 68.5 percent. In other experiments the average annual runoff increased on strip-cropped plots by amounts ranging from 3.3 percent to 23.8 percent.

Results from 17 terracing experiments in seven states covering a period of two to 13 years shows a reduction in soil loss from the terraced areas as compared to unterraced fields. The reduction in average annual soil loss per acre varied from 36.8 percent to 98.5 percent with an arithmetical average of 95 percent.[4]

From 14 of these experiments the average annual reduction in runoff due to terracing was 44 percent. The other three experiments gave increases in runoff of 5.1 percent, 8.2 percent, and 38.5 percent respectively.

While both strip cropping and terracing gave some negative results in reducing runoff it should be noted that the occurrence of negative results are in the minority and by much smaller percentages than those of positive value. It is also significant that soil losses were reduced in every experiment.

Runoff and erosion are both reduced by the uses of stubble mulch or organic residues applied to the surface. Experiments in Nebraska over a two-year period showed runoff from clean plots 2.4 times as great as from those that were mulched, with erosion 3.9 times as great from the clean plots.[5] Peele[6] reports that the use of 2.5 tons of mulch per acre in South Carolina on four soil types reduced runoff from an average of 18 percent on the un-

mulched plots to .3 percent on those mulched. Soil loss from the nonmulched plots averaged 2,400 pounds per acre, that from the mulched only 20 pounds per acre.

REDUCTION IN RUNOFF DEPENDS ON MANY FACTORS

A study of the effect on soil and water losses of treating pastures with phosphate on steep slopes on Dunmore soil in Wythe County, Virginia[9] shows that soil losses were reduced in every case. Such fertilizer treatment reduced the soil losses to amounts varying from 5 to 652 pounds with an average of 130 pounds per acre per year for the treated plots as compared to untreated. Seven of the 12 treated plots showed decreases in water loss and five showed increase. The average loss was 8,200 gallons less per acre per year for the treated plots.

Studies of pasture furrowing along the contour in Missouri showed an average loss of 2.58 inches of rainfall as runoff in 1940-41 as compared with 3.14 inches for an untreated pasture. At Ft. Collins, Colorado, the average moisture content from two samplings in December and February in the top four feet of soil was 7.2 inches of water on the furrowed area and 5.3 inches for the unfurrowed.[10]

From runoff measurements on watersheds near Freehold, New Jersey, Hobbs[7] has prepared curves based on runoff records of over five years that show interesting results of the value of conservation practices on areas up to about 20 acres.

On sloping land with light-textured, deep well-drained soils the curve indicates that for a 20-acre watershed the expected 10-year frequency peak rate of runoff would amount to 78 c.f.s. for row crops up and down slopes; 44 c.f.s. for contour cultivated row crops; and 35 c.f.s. for pasture.

On sloping land with medium-textured, shallow, imperfectly drained soils, strip cropping is estimated to produce 73 cubic feet per second of runoff from 20 acres, and pasture 46 cubic feet per second, as compared to 35 cubic feet per second from deep pervious soils under pasture grasses.

Flood control studies provide some interesting information on runoff reduction from tributary watersheds. In a summary of the U. S. Department of Agriculture's flood control studies, Cook[8] estimates that the application of soil conservation practices on watersheds with deep soils will reduce the small frequent floods by amounts varying from 20 to 40 percent, and large floods from 5 to 15 percent. On thin-soiled watersheds the reductions obtainable by treatment of the land are minimized. The inability of the shallower soil reservoir to hold all the additional water delivered obviously results in decreased infiltration capacities. Nevertheless, small floods in the growing season may be reduced by percentages varying from 10 to 30, and those occurring in the nongrowing season may be reduced from 0 to 5 percent.

There are many sources of sediment. Brown[1] has listed seven. Of these, two are of most importance from the standpoint of farmed land: (1) Sheet erosion caused by raindrop splash and surface runoff (wind erosion is not considered in this paper); (2) gullying or the cutting of channels by concentrated runoff. A third, stream bank erosion, may cause heavy damage in specific cases but the type of control measures needed are not generally considered to be farming practices.

SHEET EROSION PRODUCES SILT

Research studies and watershed surveys by the Department of Agriculture have shown that sheet erosion generally produces the greatest quantity of silt in areas that are predominantly agricultural and have more than 20 inches of rainfall. Sediment that causes particular problems such as channel aggradation, however, may come primarily from gullying or other sources.

Considering both the experimental data and the results of many field observations by hundreds of soil conservation technicians working throughout the United States, erosion specialists of the Soil Conservation Service have reached certain conclusions with regard to the average effects of some important differences in land use and in farming practices. Assuming that all natural factors, such as climate, soil, and slopes, are the same and that the erosion loss from continuous row crops, such as corn, cotton, and tobacco, represents 100 percent, then erosion losses from small grain (wheat, rye, oats, and barley) will range from 15 to 40 percent. Good hay land, pasture and woodland will have comparative losses of less than 1 percent. Well-contoured row crops will have an average erosion loss of approximately 50 percent of straight row cultivation. A good 3- or 4-year rotation will give losses of 14 to 45 percent of those resulting from continuous one-crop cultivation. Strip cropping will reduce losses anywhere from 25 to 45 percent of those caused by continuously cultivated crops.

CONSERVATION FARMING REDUCES SEDIMENT LOSSES

With respect to larger watersheds the quantitative data on both runoff retardation and sediment reduction is admittedly fragmentary. There is convincing evidence, however, that conservation farming produces benefits by reducing sediment losses.

On the 62-square-mile watershed of the municipal reservoir of High Point, North Carolina, soil conservation measures applied on about 35 percent of the total acreage caused a reduction of 24 percent of the rate of sedimentation for the period 1934-38 as compared with the earlier period 1928-34.[1]

By reforestation and gully control on an 890-acre area

of rolling and badly eroded land above the municipal reservoir of Newman, Georgia, the rate of siltation was reduced 62 percent during the period 1937-45 as compared with the earlier period 1925-37.

Increasing sediment production has been shown to result from increasing intensity of land use for intertilled row crops in the Sangamon River Watershed in Illinois.[11] The increase in the rate of silting of Lake Decatur has already been referred to by Mr. Carl Brown. The 906-square mile watershed of this reservoir is a broad, gently-rolling glacial drift plain, with black prairie soils predominating. In 1943, approximately 31 percent of the land was in corn, 33½ percent in soybeans, 11 percent in small grains, 14½ percent in hay and plowable pasture, 2 percent in woodlands, and 8 percent in other uses. The 20 percent increase in the average rate of sedimentation during the 10 years from 1936-46 as compared to the preceding 14 years, is attributed to progressive increase in intensity of land use for intertilled row crops. In Piatt County, land in row crops increased from approximately 39 percent in 1924 to 64½ percent in 1943. The increase was due mainly to soybeans. The amount of soil conservation measures on the watershed was negligible; less than 2 percent of the land was under treatment in July 1946. Analysis of the lake sediments and other studies indicated that silt was derived from all parts of the watershed. It is estimated that 90 percent comes from sheet erosion primarily from corn and soybean fields on slopes of 2 to 15 percent. Only 10 percent, or less, comes from gully, stream channels and shoreline erosion.

CONCLUSION

In conclusion it is estimated that in most agricultural watersheds with relatively deep soils in rainfall areas exceeding 20 inches per year silt production can be decreased at least 50 percent, and more in many cases. Under favorable conditions annual surface runoff from small watersheds may be decreased by amounts ranging up to 30 or 40 percent by universal application of adapted soil conservation measures without reducing the regional level of agricultural production or net farm income. In fact, income will be increased in most instances according to experience of conservation farmers in the last 10 years. This degree of runoff and silt reduction, however, is contingent upon practically unanimous cooperation of landowneds and operators in using the land in accordance with its capabilities and in treating the land in accordance with its needs. To accomplish such reductions will require continuous technical services of trained conservationists in planning, installing, and maintaining conservation practices. Furthermore, the conservation measures used must comprise a complete conservation program. Many practices not mentioned in this paper will be needed.

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Retarding and Impounding Structures Aid Control of Runoff and Siltation

THOMAS MADDOX, JR.

The use of structures as a means of reducing run-off and siltation in relationship to watershed management is presented in this paper by Thoma Maddox, Jr., of the Reclamation Bureau. Mr. Maddox is located at Denver, Colorado.

THE USE OF IMPOUNDING or retarding structures in the control of runoff is well known. Practically the whole of our irrigation developments in the West are dependent on impounding structures for the regulation of stream discharge, either seasonal or cyclic, and all over the country we have structures for the regulation of stream flow or for power production, for the temporary storage of flood waters, and for storage of water

for the improvement of facilities for navigation.

Not so well known, perhaps, is the use of structures for the impoundment or retardation of sediment; but such uses will probably increase in the future. At the present time structures for sediment storage are usually small, but it is highly probable that within the next 25 years major structures costing a million dollars or more will be built for the purpose of impounding or controlling sediment movement in some of our main stream systems.

Because of the limited time available in this roundtable, I want to confine my remarks to a discussion of the use of structures for sediment control.

In many parts of the United States, but particularly the Colorado Plateau province and parts of the Missouri Basin, climate, topography and soil characteristics are such that under virgin conditions, sediment loads are high. Furthermore, in many parts of these and other sections of the country, past land use has been such as to cause or induce greatly increased sediment loads in our streams. In many cases, erosion has progressed to such an extent that there seems little likelihood of repairing the damage by natural means. In other locations in the country, areas have been occupied or settled that are naturally hazardous and cannot be protected by natural means.

STRUCTURES FOR SEDIMENT CONTROL

In all of these cases or their combinations, structures for sediment control can be and have been justified. Numerous structures have been built in Los Angeles County, California, and along the Wasatch Front in Utah for the control of sediments that would normally be deposited on alluvial fans. The normal sediment movement in both these areas has been accelerated by land use and in both areas topography and soils are such that normal sediment movement is relatively high. On the Navajo Reservation many structures have been built for the storage of sediment and perhaps more particularly for the reclaiming of badly gullied valley floors. There the streams have eroded to such an extent that the new grade of the stream is so much below the old that stern measures have to be taken to prevent additional widespread gully development. Structures for the same purposes, usually on a smaller scale, have been built in many parts of the United States.

The most obvious and perhaps the least valuable use of storage structures for sediment is the actual retention of sediment. Unless the capacity of the structure is large in relation to the sediment inflow, it soon becomes filled and the problem of disposal of sediments or increasing storage must be faced. In Los Angeles County, California, debris basins are actually cleaned out after major floods at constantly rising costs. Along the Wasatch Front in Utah the practice has been to raise the impounding structure. In either case there is an economic limit to the attempt to maintain storage capacity for sediment. This must take place despite the fact that the storage capacity for sediment in a retention dam is much greater than the water capacity.

Perhaps the most effective use of structures is where the filling of the channel upstream not only provides for storage of sediment but also eliminates a source of the sediment load. Although it is usually thought that the grade of deposits in back of a dam will parallel the original stream grade, I know of only one case where this has taken place. In this case the sediment deposit in back of a small structure was eventually covered with heavy vegetation after persistent work. In a study of numerous dams and debris basins in Arizona, New Mexico, Utah and California, the Soil Conservation Service found that the grade of the deposit in back of structures was about 70% of the original grade. Streams carrying coarser loads more closely approached the original grade. Some of the structures studied were over 10 years old. It is apparent, however, that a grade of deposition of 70% of the original grade will produce a rise in the stream bed for some distance upstream with a consequent reduction in the height of exposed banks.

While most of the effects of structures are to be expected upstream, downstream effects both favorable and unfavorable are also found. In the Middle West considerable stabilization of channels downstream from soil savings dams has been effected. This has resulted from the regulation of discharge afforded by the unfilled dams. The regulated discharge allowed vegetation to become established so that when the dams finally filled with sediment and regulation was lost, the vegetation was still able to protect the channel.

On the other hand, the entrapment of sediment in back of structures has been responsible for a deepening of and accelerated erosion below the structure. The overpouring water simply picked up a new load as it moved downstream. This phenomena has been observed below practically all of the major reservoirs in the west and of course is on a large scale.

DESIGN AND MAINTENANCE OF STRUCTURES IMPORTANT

There are two factors that must be taken into account if structures are to be successful. First, the structure must be designed so as to be safe under a wide range of discharges. This means that the structure, usually placed on poor foundations, must not fail from piping, flanking or undercutting. Failure to provide adequate

safety in design has been responsible for structural failure with disastrous results. Adequate design costs money. It is not possible to design a really cheap structure where water falls distances of 15 or 20 feet or more, nor is it possible where discharges to be expected are over a few hundred c.f.s. This in itself has limited the applicability of this type of erosion control measure.

Second, structures must be maintained. Even the best designed and constructed structure needs maintenance. In most cases it is simply the question of a stitch in time saving nine. However, in too many cases structures have been built and then forgotten until something happened and they were lost. Unless some sort of an organization for maintenance exists, either private or public, the use of structures should be approached with caution.

In spite of these drawbacks, structures for sediment retention have a real place in an erosion program, although, I will say that it seems to me that they seem to be more needed in the West than they are in the Middle West and the East. The structure is most effective in controlling the coarser sized fractions of the sediment load. This load moves in suspension only during the highest discharges, the remainder of the time if it moves at all it moves as bed load. The structure hardly affects the finer fraction of the sediment load unless storage is exceptionally large, and usually this is not the case. It can be stated, therefore, that structures have the greatest value in preventing downstream aggradation, since this in nearly all cases is caused by the coarser fractions of the sediment load.

The reason I suggest that structures have a greater value in arid regions than in more humid regions is this: In the West practically all of our streams are used for irrigation. Irrigation depletes stream discharge without reducing the sediment load since precautions are taken to keep sediment out of the canal system. This means that less water is available to move sediment down the stream channel. Furthermore, since most streams used for irrigation are regulated, the sediment carrying power of the stream is still further reduced. It becomes apparent, therefore, that the use of the water in our western streams introduces problems in sedimentation that would be non-existent under pristine conditions. The judicious use of structures may be the only means of solving problems to be expected in the future.

A still further use of structures is apparent in the West. For many years there has been shown the need to preserve the storage capacity of our western reservoirs. It is very probable that it will be desirable to protect and prolong the life of our best reservoirs by the storage of sediment at strategic locations upstream. Damsites that may not be good locations for reservoirs may be good for sediment storage. Furthermore, as the deposition of sediment in existing reservoirs has progressed it has become apparent that deposition at the head of reservoirs has introduced the problem of increased water losses from non-beneficial consumptive use. Here again, control of sediment by structures on the watershed can have a marked effect by reducing the movement of the coarser sediments. Although this loss due to deposition has not yet received a great deal of consideration, it may become one of the controlling factors in the use of water from our western streams.

More Than One Hundred Years Ago

"We fit our convoys of ships, at great expense, to gather up at the South Pole, the droppings of petrels and penguins, and the incalculable element of wealth which we have under our hand, we send to the sea. All the human and animal manure which the world loses, restored to the land instead of being thrown into the water, would suffice to nourish the world.

"These heaps of garbage at the corners of the stone blocks, these tumbrils of mire jolting through the streets at night, these horrid scavengers' carts, these fetid streams of subterranean slime which the pavement hides from you, do you know what all this is? It is the flowering meadow, it is the green grass, it is marjoram and chyme and seage, it is game, cattle, it is perfumed hay, it is golden corn, it is bread on your table, it is warm blood in your veins, it is health, it is joy, it is life.

"You have the power to throw away this wealth, and to think me ridiculous in the bargain. That will cap the climax of your ignorance."—VICTOR HUGO.

Conservation and a Permanent Agriculture

(*Continued from page 20*)

today. When we analyze the land resources needed to give our people the abundance they want, we realize that we haven't an acre to spare; that, in fact, such abundance will require the use for some time of land in row and close growing crops which is subject to continuing erosion. But looking ahead we realize further that the pattern of agriculture which will give us abundance is approximately the same pattern needed for adequate conservation. *Abundance means more meat and milk, more hay and pasture. Conservation means less land under plow, more land under grass.*

With conservation and abundance complementing each other as they do, we have no practical alternative but to incorporate the two into a long-range program—a program leading not only to a permanent agriculture but also a better living for farmers and consumers. Past experience gives us confidence that this Society and its members will have an active part in the accelerated drive toward that end.

Planning Range Conservation on Western Ranges

W. T. WHITE

Mr. W. T. White discusses the importance of grazing and the adjustment ranchers need to make when adopting a conservation plan. He also describes some indicated results coming from a typical ranch conservation program. Mr. White is Chief of the Range Division for The Soil Conservation Service, with headquarters at Portland, Oregon.

GOOD CONSERVATION PRACTICES applied to grazing lands on our western ranches have doubled yields of forage and expanded several fold the opportunities for profitable beef, mutton and wool production. They have also justified increased facilities for improved management, and raised the living standards for ranchers and stockmen.

Profitable livestock production on most western ranches rests upon the quality and amount of range and pasture available on the range. Good range is the rancher's cheapest source of feed, for rapid gains and for maintenance of breeding herds. The number of calves and lambs raised and their sale weights are generally accepted measures of successful ranch operation. The highest calf and lamb crops as well as the most rapid growth of young animals are invariably on ranches having an abundance of succulent range forage.

Importance of Grazing in Ranch Economy

Many successful ranchers recognize that sustained livestock production must rest upon improved yields of grazing land, conservative grazing, maintenance of good livestock and other phases of sound management of both grazing land and livestock. Few ranchers, however, also appreciate the full worth of setting up and maintaining on their ranches an effective balance between forage grown on grazing lands and that of harvested crops, so that the feed required by the livestock for each season of the year will be ample for full livestock growth and gain. Still fewer graziers and livestock operators regard themselves as being primarily in the business of growing grass, and that good, thrifty livestock only provide the most economical way of harvesting their range and pasture and converting it into useful products.

The fact that grazing lands in good condition do produce cheap, high quality feed has led many ranchers to attempt to exact more grazing from their ranges and pastures than they will stand without serious deterioration. Misuse of grazing lands occurs in most instances where ranchers have too little winter feed to carry their livestock through a full winter period. Too often they attempt to make up the deficiency by staying on the range too long in the fall, or by turning out too early in the spring. This physically injures and dwarfts good forage plants. The reverse situation also occurs where a rancher has ample feed or, in some cases, a surplus of feed. This, in a surprising number of instances, leads to the rancher's misuse of his range. Because of his ample feed supplies, he withholds stock from market to consume his winter feed, then subsequently attempts to carry his animals through the next grazing period, thus overloading his range or pasture.

Sound planning takes these and similar ranch problems into account and provides adequate adjustment and remedial measures.

Blue-Printing Ranch Operations

Applying good management to grazing lands and the designing of sound conservation practices are in themselves relatively simple actions on the part of ranchers. They require adherence only to four widely recognized principles. These principles as generally stated are: (1) prompt adjustment of livestock numbers in harmony with available seasonal forage, (2) adjustment of the season of use for each grazing unit or pasture to meet the growth requirements of the principal forage plants, (3) erection or relocation of fences, and stock-water facilities, and salting stations, to obtain proper distribution of the grazing animals, and (4) maintaining the best kind of forage which the particular ranch can grow.

Ranchers who adopt these principles as a guide, find the need of a careful organization or reorganization of their operations. Conservation practices or remedial measures when applied in a systematic and effective manner to the range and dependent croplands, always pay off in increased and sustained yields.

Shifting to a plan-wise program of grazing-land improvement and the maintenance of a high level of production generally brings the rancher face to face with a variety of problems. Some are extremely difficult to solve. Many are of long standing. Some require far-reaching changes in ranching methods for their effective solution.

Adjustments Ranchers Make When Adopting a Conservation Plan

Typically, ranchers in planning for grazing-land improvement are faced with such things as:

The urgent need for early rehabilitation of part or all grazing land now depleted to a point where it is yielding

only one-fourth to one-half of what it is potentially capable of producing.

The need of an increased supply of hay, grain, and supplement pasture, so as to avoid continued destructive early- and late-season grazing use of their grasslands.

The need of adjustment in livestock numbers to halt the continued downward trend and depletion of their grazing lands.

The need of sharply revised grazing or herding methods.

The need for improving the low quality of farm-grown feeds, so that they will provide satisfactory maintenance of livestock during the late fall, winter and early spring, and insure good health and vigor of the animals as they are turned to grazing in the spring. Low-quality feeds become especially unpalatable to livestock as new grass appears. This factor, alone, frequently influences the rancher to turn his livestock to pasture or range so early as to injure the new growth of forage.

The management practices that influence the movement of livestock and those that insure even grazing over each entire unit are especially important. Such things as poorly arranged fences, inadequate or poorly located stock water, poorly planned salting systems, the occurrence of natural barriers, rough or steep topography, badly shaped ranches, such as long narrow strips or L-shaped grazing areas that prevent stock from grazing all the forage, are frequently the kind of problems that have to be considered in securing proper grazing distribution.

PLANNING CONSERVATION FOR GRAZING LANDS

The design and integration of new and revised ranching practices on most livestock ranches require careful attention to detail and timing of application, in order to avoid unduly upsetting current operations or endangering the rancher's financial structure. Blue-printing the introduction and application of practices and the organization or reorganization of a ranch is called ranch planning.

A practical first step in planning for good grazing land management is to make an inventory of the ranch resources. An analysis of the inventory data provides the basis for the second step — the designing of remedial measures and sound land use practices for all the ranch, and determining an orderly sequence of applying the measures and practices on the ranch. An essential part of every plan is a provision for annually making checks to insure that planned practices and remedial measures may be promptly adjusted to meet local climatic and market conditions.

The first step in developing a sound ranch plan is to make an inventory of the livestock, the range and pasture, the cropland, and the kinds and amounts of feeds and forage available to the rancher.

Livestock. The rancher determines the number of livestock kept or desired to be kept on the ranch for a profitable livestock enterprise. Among other things, the marketing practices (sale of weaners, yearlings or two-year olds in the instance of a cattle operation) are determined. The question of when, how many, and at what age livestock are sold markedly influences the required amount of grazing and other feeds needed seasonally.

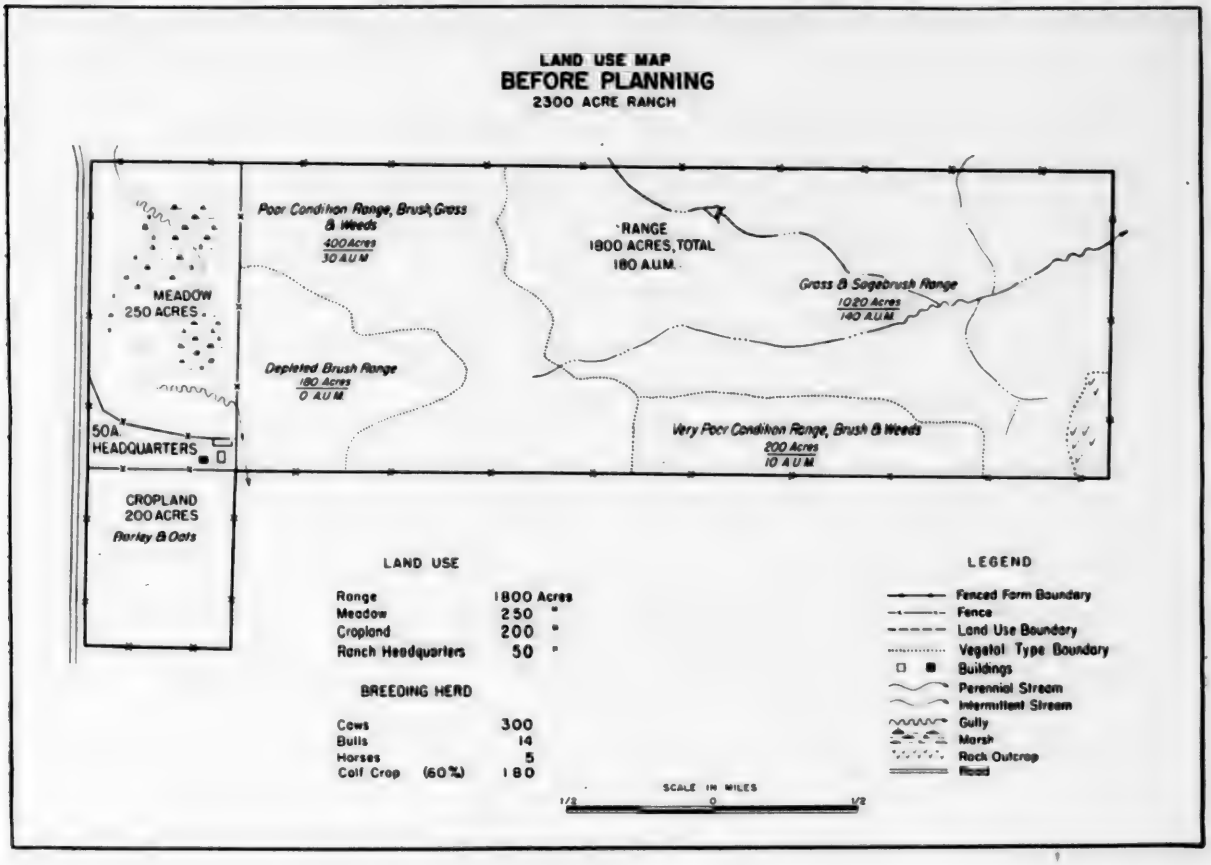
Range or Pasture Condition. The conditions of the various parts of the grazing units are determined to establish the amount of forage the various units may be expected to produce under an improved plan of grazing, and the seasons during which the forage can be grazed to best advantage. This information when analyzed is shown graphically on a range condition map of the ranch, and becomes the basis for applying conservation practices and remedial measures to the range.

Croplands. The suitability of the ranch croplands for producing the required roughage, grain, and supplemental pasture is based upon the adaptability of the soils of the ranch fields for growing the needed crops as determined by a conservation soil survey. This information weighed against the current field-by-field production of these crops and the season of the year in which the crops become available for livestock feed is analyzed and recorded. The cropping history of each field is noted as a guide in planning future cropping.

Feed and Forage. The roughage, grain, and pasturage requirements for the present (and desired) numbers of livestock are calculated in terms of animal-unit-months for comparison with the estimated production of the cropland and grazing lands of the ranch. This information when analyzed shows the estimated amount of the various feeds and the seasons of the year when the feeds must be available for livestock. If total livestock requirements are greater than feed produced on the ranch, or if there is an over-supply of forage available at certain seasons of the year, or a shortage of total winter feeds, definite plans are made for adjustment either in the numbers of livestock kept on the ranch or in the crop and grazing-land acreages.

THE RANCH CONSERVATION PLAN

The second step, once the inventory has been completed and the several factors analyzed, is to set down in writing a plan of the operations of the ranch for a three- to five-year or longer period. The plan then becomes a guide and constant reminder of the orderly pattern for



applying new practices and remedial measures especially designed for the improvement and conservation of the particular grazing and crop lands.

The range, feed, and livestock-inventory information plus the cultivated land capability information, which is shown graphically on a map, give a picture of the land now in crops and other land that might safely and profitably be cropped. It provides the basis from which the ranch-conservation plan is developed. The plan is then finally revised and completed by comparing it with the needs and desires of the rancher and with his livestock, soils, and forage resources. The total available feed resources are based upon calculated production of crops that can be grown on the cultivated pasture and range lands. Commonly, most ranchers can reorganize their present operations by doing one or more of the following things:

1. Providing for seasonal and annual adjustments of livestock numbers and management practices to avoid overuse of grazing land or the hazardous depletion of feed supplies.
2. Planting crops and supplemental pastures that will overcome seasonal shortages and thus balance the year-long requirements of feed or forage for the desired number of livestock.
3. Revegetating depleted grassland acres to aid in overcoming seasonal shortages in forage resources.
4. Providing enough feed and forage reserves to meet climatic fluctuations and consequent fluctuations in the yearly feed and forage supply.

Balance between Available Feed and Livestock

An important consideration is that the kind and character of the feed and forage crops to be grown be planned in harmony with the capabilities of the cropland. Developing systematic crop rotations is one way of improving and maintaining cropland, and when carefully designed, they also insure the production of adequate hay and grain, plus a reasonable reserve. They provide needed flexibility for extra feeding during an early winter or a delayed spring. The kind and amount of feed crops required are planned to be in balance with the seasonal feed and forage livestock requirements. This provision makes it possible for the rancher to avoid grazing the grasslands when the soils are wet and unstable, or

before forage has reached a safe degree of growth for grazing.

Where a rancher's cropland produces more hay and grain than required for the normal wintering of his livestock, part of the cropland may be planned for cash crops, or such surplus feeds may be used for putting a higher finish on all or part of the livestock to be marketed. On other ranches, such cropland may be converted to summer pastures to relieve the grazing pressure on ranges and pastures. Ranchers also find it profitable to use cropland to provide high quality forage for young stock or breeding stock at those seasons of the year when the native ranges and pastures have dried up and have lost much of their nutritive value.

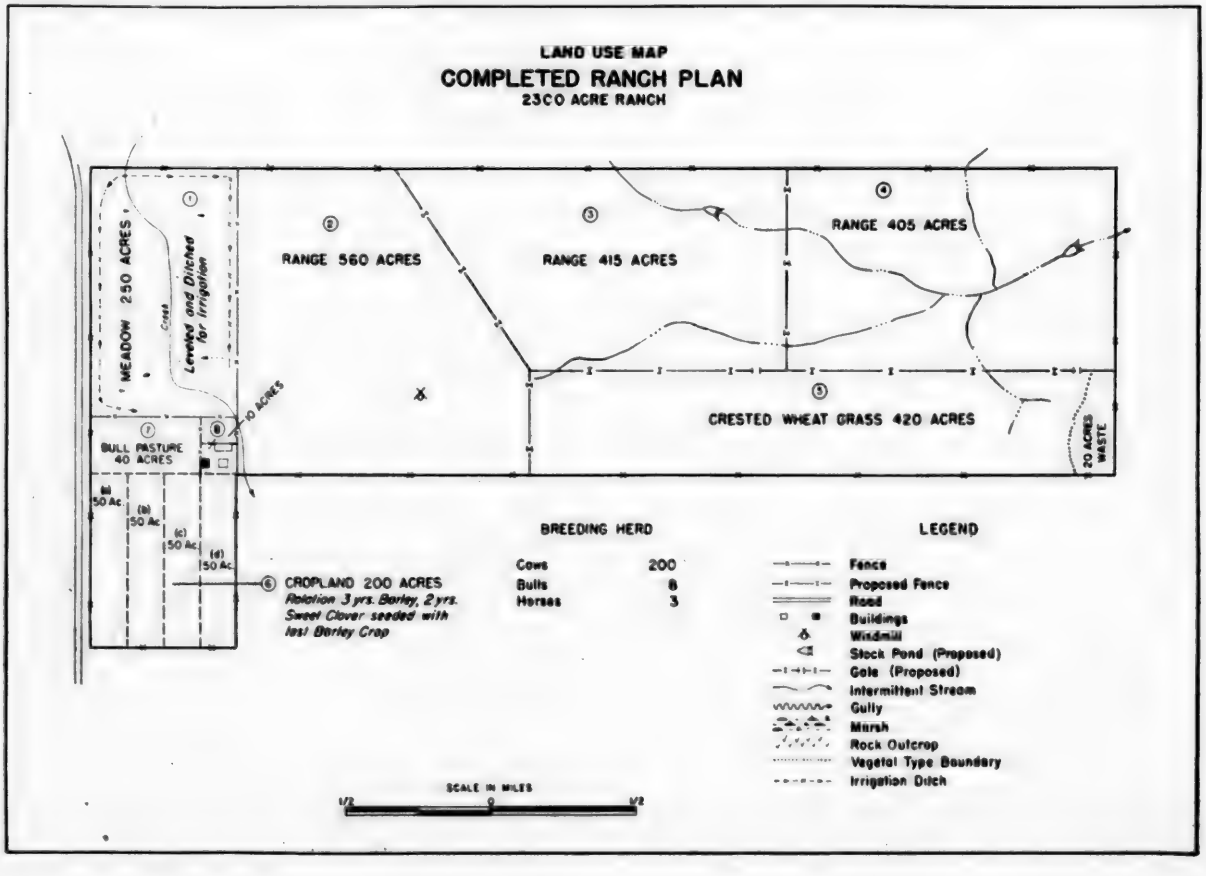
Land now in crops unsuited for cultivation is converted to permanent pastures for summer grazing, a resource needed on many ranches to relieve current pressure on the range and to make possible the rapid adoption of deferred-rotation systems of grazing.

Croplands and abandoned croplands are generally the first considered as a possible ranch source of increased grass and forage needed in conservation planning. Reseeding range land and the improvement of range conditions are processes characteristically too slow when new feed and forage supplies are immediately needed to balance the year-long feed requirements. The reseeding of range or pastures, or the improvement of range conditions are planned to attain longer range objectives.

When annual yields of cultivated lands of the ranch have been determined on the basis of a cropping plan for each field, the plan of grazing for each of the range and pasture units, based on condition of the range or pasture, type of forage, accessibility of forage (i.e. distance from water, topography, elevation, and exposure), the estimated yield of each grazing unit, and the season of the year in which it can be properly grazed is determined.

A comparison of the feed requirements for the livestock kept on the ranch each season of the year, with the estimated yields in terms of animal-unit-months (amount of forage, roughage, or concentrates required to feed a 1,000 lb. animal for one month) of the cropland and grazing lands, provides the information for making adjustments in the amount of grazing land, cropland, or the number of animals maintained on the

(*Continued on page 54*)



Writing Soil Conservation News for Your Local Paper

LOUIS REID

LOUIS REID is connected with the Division of Information, Soil Conservation Service, Fort Worth, Texas. "Writing Soil Conservation News for Your Local Paper" is an informative article and should be helpful to conservationists and other agricultural workers in getting together material that local editors want.

THERE IS PLENTY of soil conservation information worth publication lying around. Editors are glad to get it. You can write it. I've never met a man smart enough to carry on a normal conversation who isn't perfectly able to write good soil conservation news.

I have met a lot of intelligent men who think they can't write soil conservation or any other kind of news. Facts are, they can; they just don't know it yet.

Here's the deal. Editors—editors of newspapers and magazines and radio programs and house organs—want information about what people are doing. If people are carving away at each other's gizzards with butcher knives, the editors want to know about it. They want to carry the story in their paper. If people are attending the monthly 18th Street Garden Club meeting, the editors want to know about that. And they want to carry the story. For exactly the same reason, if people are out in the fields doing soil conservation work, the editors want to know about it and they want to print the story.

Where does that get us? Back to the fact that editors want to print news about people and their activities.

Soil conservation is an activity of people: editors want stories on soil conservation.

Now these assertions aren't guess. They're based on several years' actual experience on metropolitan newspapers and on several other years' observation of news written by field technicians of the agency for which I now work. In the 12 months ended July 1, 1947, those technicians wrote more than 12,000 news columns dealing with soil conservation. Almost to a man, those technicians have no training in writing. Rather, they are agronomists and engineers and ecologists and soil scientists.

I've heard those technicians shout, cry and moan when I suggested that they begin reaping the benefits which a sound conservation news program brings to the cause of coordinated soil and moisture conservation. "I can't write anything," they've told me. "I don't even write my poor old mother who's pining her life away for lack of word from me."

But later, after I've passed the know-how of writing conservation news on to those technicians, I've had the pleasure of talking with some of the editors in their neighborhoods. "Say," one told me not long back. "Old John Brown down there is sure doing a good job of getting us news of what's going on in soil conservation. We can use all that kind of copy he'll bring in."

What is it that I tell technicians to convert them into mighty penmen? Well, here roughly is the spiel I put up to them.

First, I get over the point I've already mentioned: that editors want information of what people are doing and that soil conservation work is one of the things they are doing. Then I'm prone to say, "John, every day you get in your little green pickup truck and you go out to this or that farm. And while you're out at the farm, John, you work with the operator on one of the conservation measures his place needs. Maybe you stake out a terrace outlet. Or show him how to seed the tiny weeping lovegrass seed at no more than a quarter or a half pound an acre. Possibly you are there to help him determine the condition of his range or pasture, and to see if it is improving or not under present grazing practices. My point, John, is that while you are out with the farmer you are doing some kind of conservation job. Right?"

"Right," John will say. "That's what I do, since I'm a conservation technician. I do that and all the men in this office do about the same thing. We've been doing it for years. We go on a lot of farms. But we are supposed to be talking about writing soil conservation news. What are you getting at?"

"John," I tell him, "each time you go on a farm to do a conservation job you and the farmer create one or more conservation news items. You've created the item whether you go the extra step and put it on paper or not. The news exists. You might as well harvest it. If I ask you what conservation job you did today you tell me. You tell me who the farmer is that you visited, you tell me where he lives, what he's doing, and why he's doing it. Your answer is a news item if you write it down.

"Suppose the thing you did was to run a check on the condition of his native pasture. Say the place is Bill Jones'. He lives west of Gary in the Dry Creek neighborhood. For the sake of the example, let's note that Bill Jones has been running 80 head of cattle four months of the year on a one section pasture. And say the sideoats grama shows an increase and broom snakeweed is declining."

Stripped to its essentials, here's an item we could write about Bill Jones' work:

> Good quality sideoats grama is increasing and inferior broom snakeweed is losing out in a 25-acre pasture on the Bill Jones ranch west of Gary in the Dry Creek neighborhood, a check this week showed. Jones says the improvement has come as a result of improved grazing practices on the pasture.

Now that's the basis for the conservation item. By itself, just that one paragraph is a complete news item. An editor in the range country probably would print it.

Of course, you can elaborate a great deal on the item. You can write about the actual composition of the range now. Contrast it with the precent and kind of plants on the range when Jones began his proper stocking. You can compare Jones' pasture with other pastures which have received different treatments. You can tell what the stock weighs when it is turned on the pasture; what it gains. You can extend that information to your whole area—assert that such treatment is benefiting Jones; therefore it would benefit all.

The technique is an adaptable one. Say you need to get across the need for several of the various conservation measures farmers need. Your problem is simple: report on men who are doing such work. Tell their results. What they think of the procedures. Your reader is perfectably able to judge for himself, after he has such facts in hand, whether he wants to know more about the methods being discussed.

That works fine so long as someone in your vicinity already is using the conservation practices you are trying to promote. But say the practices are new; that no one is using them yet. When that is true, immediately you know two things. One is that you don't have conservation news, because conservation news is a report of what people are doing. The other thing you know is that you need to write a feature story. Not an editorial. An editorial is the place that an editor expresses his opinions. Your own opinions don't belong either in news or feature stories.

Writing a feature story is a much harder job than writing news. With news your task is merely that of being an observer. When it's a feature, you have to supply both the facts and the writing. Usually you don't wish to push new practices until you've seen them working in your locality. You ordinarily get some one or two willing farmers to give the new measures a trial before you reach the point of suggesting them to the entire locality. When you do get ready to tell everyone in your neighborhood about your new practices, then, usually you have the experience of your one or two trial farmers to discuss in your news item.

But in the few instances where it is not practical to wait for local results before writing, you have a feature story on your hands. Go to all available sources for information of the new measures you need to discuss. Accumulate every fact about the subject you can lay your hands on. Then make yourself an outline. Distribute your information along the outline where it seems to fit best and then start writing. If someone with writing experience is available, get him to review your manuscript. Then give it to the editor.

Writing conservation news is a job any agricultural technician can do if he'll just report what is going on. Writing conservation features actually is a task for a person with experience in writing. Avoid the feature story if you can. There's always so much conservation *news* floating around the nation's soil conservation districts that almost never should it be necessary to fall back on the conservation *feature* story to maintain an adequate conservation information program.

What Is Soil Conservation?

Soil conservation is the proper use and care of the land. It means using the land to produce the greatest amounts of the things we need and at the same time protecting the land so it will not lose its productiveness. Soil conservation is one of the youngest of the agricultural sciences and one of the most exacting. Real, permanent conservation must be well planned and executed in accordance with sound scientific principles. At the same time it must be reduced to simple, practical terms and methods so that the farmers who work the land may understand it and use it as a part of their everyday operations.

Plans for Perpetuity

The primary reasons for public interest in soil conservation practices on private land arise because (1) soil resources have a greater economic life for the public than for the private individual, and (2) there may be a desire or a necessity of maximizing efficiency in agricultural production of the country. A reason frequently given for governmental agricultural conservation programs is that the nation must make plans for perpetuity while the individual farmer makes plans only for the period which he plans to operate the farm.—*From an address by* AARON G. NELSON, *Farm Credit Administration, Omaha, Nebraska, before the annual meeting of the American Farm Economic Association held in Green Bay, Wisconsin, Sept. 19, 1947.*

Recent Research Reviews

JAMES H. STALLINGS

THE REVIEWS by J. H. Stallings that follow are a regular feature in the JOURNAL. It is hoped that the projects reviewed from time to time will be helpful to conservationists everywhere. Members of the Society are urged to indicate their interest in the kind of research work that should be reviewed.

A Guide to Degree of Range Use in Southwest Texas. *By* BEN OSBORN. *The Cattleman, Vol. 34, No. 5, pp. 124-126. October 1947.*

The author outlines a simple scale for judging degree of pasture use which enables ranchmen to stock ranges properly and avoid damage from overgrazing. It enables one to compare, at any time, the amount of grazing that has taken place in a pasture with the degree of use that is safe for the kinds and amounts of vegetation present under the current season's growing conditions.

The scale is based on the fact that livestock have marked preferences for certain kinds of range plants. They will graze the more desirable plants before using the less palatable ones to any extent. It happens, too, that the plants which stock select for grazing first are generally the ones which are most nutritious and which have the capacity for producing the greatest volume of feed. Consequently, if range is to remain in condition to produce the greatest amount of the best quality feed year after year, grazing must be limited to avoid damaging the preferred plants.

Erosion Control by Tillage Demonstrated in Tests. *By* T. S. AASHEIM. *Farmer Stockman, June 1947.*

The author reports the results of two projects conducted for the purpose of determining the effect of tillage method on soil and water conservation and crop production. One project was started in 1940 at Froid, Montana and the other in 1941 at Havre.

Neither wind nor water erosion have been severe on any of the plots at Havre but at Froid the value of trashy fallow for erosion control has been demonstrated several times. The subsurface tilled, trashy fallow has been the only fallow which has not blown at some time or other since the project was started. Some wind erosion has occurred every year but never on subsurface tilled plots where stubble was utilized.

Building a Soil Deeper. *By* D. D. SMITH, C. M. WOODRUFF *and* D. M. WHITT. *Agr. Eng. Vol. 28, No. 8, pp. 347-348 and 353. August 1947.*

Deep plowing accompanied by deep liming and fertilizing produced a 31 percent increase in yield of corn over normal methods on a claypan soil of central Missouri. The cost of the additional mechanical and fertility treatments was more than repaid by the increased yield from two corn crops at present prices.

Engineering and Agronomic Phases of Mulch Culture. *By* G. B. NUTT *and* T. C. PEELE. *Agr. Eng. Vol. 28, No. 9, pp. 391-393. September 1947.*

Farming methods designed to leave a considerable portion of the residue from preceding summer or winter crops on the soil surface as a mulch during the growth of row crops or small grains have been proven agronomically feasible and practicable for the piedmont soil provinces. Maintaining crop residues on the soil surface is a much more effective method of reducing runoff and erosion from areas where corn or small grains are growing than plowing the residues under and using conventional clean tillage practices. Also, short-time trends indicate that the mulch farming practices cause greater improvement in soil aggregation and a more rapid increase in soil organic matter and nitrogen in the 0 to 5 inch soil depth than conventional methods.

Knowledge of these advantages of mulches was used as a basis for developing cultural techniques and machinery, that make mulch farming practical, reported in this paper.

New machinery such as a cutoff corn picker for shredding the stalks while picking the ears will provide a source of mulch and aid in the control of insects. Many tillage and harrowing tools now in use may be used without modification for mulch culture. Others such as the middle-buster furrow opener may be developed from standard tools. There has not been a radical approach to the machinery requirements in this study. Existing tools were adapted to this system where it was possible to do so.

The Effects of Summer Ground Cover and Legume Residues on Cotton Yields. *By* WILLIAM E. ADAMS. *Commercial Fertilizer, pp. 17-18, 20 and 23. August 1947.*

It is possible to increase the yield of cotton, check erosion and improve the soil at the same time by growing the crop in good soil-conserving and soil-improving rotations. The rotation needs close growing summer cover crops, which protect the land against erosion and supply leguminous residues to the soil. The soil is made more fertile, more mellow and absorptive, less erodible, and easier to manage by the addition of organic matter.

The study covered 18 cropping systems including cotton on Class III, Cecil sandy loam soil. It was started in 1943. The treatments included the use of lime, the recommended rates and analyses of fertilizers and their

proper placement, good seed and adapted varieties, proper cultural practices, and disease and insect control measures.

The results of six cropping systems are reported and discussed.

Eradicating Mesquite. *By* RALPH W. CAIRD. *The Cattleman, Vol. 33, No. 8, pp. 23-26. Jan. 1947.*

The author discusses the results of a study conducted for the purpose of developing a practical and satisfactory method of eradicating mesquite. The study covered both chemical and mechanical methods. The relative values of the various methods tested are discussed.

Keep Legumes in Grass-Legume Pastures. *By* R. R. ROBINSON *and* V. G. SPRAGUE. The Coke Oven Ammonia Research Bureau. *Nitrogen News and Views, Vol. 2, No. 10, Columbus, Ohio, September 1947.*

Grazing management is one of the first requirements for maintenance of legumes in a grass-legume pasture. Clover may be maintained where mineral fertility is adequate, if grazing practices prevent rank growth of grass with its resultant crowding effects, under extremely high rates of nitrogen fertilization.

High rates of nitrogen fertilization combined with adapted clipping practices resulted in excellent stands of clover and in high yields of bluegrass-clover mixtures.

There was an estimated 60% stand of clover on July 16, on irrigated plots which received a total of 360 pounds of nitrogen in 1944 and 200 pounds in 1945; prior to July 16, 74 percent of the dry weight of the herbage consisted of clover.

Thus it is obvious that heavy nitrogen fertilization did not in itself eliminate clover from the Kentucky bluegrass sod.

Yields of bluegrass-clover mixture were consistently high in properly managed plots receiving heavy applications of nitrogen. The highest yield in 1944 was obtained from irrigated plots which received up to 400 pounds of nitrogen per acre and were clipped to one-half inch each when four inches high. This was 8,182 pounds of dry matter per acre, compared a with a 3,302 pound yield on plots which were not irrigated and which received no nitrogen.

In 1945, after the clover was well established, increases in yields for irrigation and nitrogen applications were not so great as in 1944. On non-irrigated, no-nitrogen plots clipped in a similar manner the yield was 7,048, compared with a yield of 8,541 on irrigated plots receiving nitrogen applications used in the tests.

All plots were uniformly limed and received annually an application of 100 pounds of phosphorus (P_2O_5) and 150 pounds of potash (K_2O) per acre.

When adequately fertilized and irrigated, good legume grass pasture may produce enough to place pasture in the same "financial return" category as potatoes and high-value vegetable crops.

Nitrifying Bacteria in Soil Conservation. *By* T. M. MCCALLA. *USDA-SCS-Soil Conservation, Vol. 13, No. 7. February 1947.*

Keeping the land covered with a close-growing crop or with dead plant residues is one of the most effective methods of controlling erosion by wind and water. One of the principal factors influencing the presence of an adequate cover of growing crop or dead plant material is the supply of available nitrogen in the soil. The available nitrogen affects directly the mass of plant growth. The nitrifying bacteria produce the available nitrogen. The presence of an ample supply of available nitrogen, together with other essential nutrients and proper soil conditions and cultural practices, is insurance that an adequate protective cover for the soil will be produced.

Placement of residues, either on the surface or in the soil, influences the action of nitrifying organisms. When residues are left on the surface as a mulch, the nitrifying bacteria are usually slightly less active than when the residues are plowed under.

In a soil conservation program it is of vital importance that the erosion control practices be in harmony with the biological activities of the soil, particularly with the nitrifying bacteria. Practices which conflict with the production of available food for the plant by these microorganisms may result in the ultimate defeat of a particular conservation method. Working with the nitrifying organisms in a manner that will produce sufficient available nitrogen for the crop will result in an adequate cover for the land, either as a growing crop or as residues to be used as mulch. This method of handling the land will result in soil and water conservation at its best.

More Nitrogen and Thicker Spacing Doubles and Triples Corn Yields. *The American Fertilizer, Vol. 107, No. 5, p. 12. September 6, 1947.*

By greatly increasing both the amount of nitrogen and the number of corn plants per acre the average yield in Mississippi might readily be trebled or raised even higher, according to the Mississippi Agricultural Experiment Station. The highest yields were obtained in all cases with the heaviest application of nitrogen and stands of 8,000 to 12,000 plants per acre. Yields were raised about 70 bushels per acre in two experiments and to 60 bushels or more in the others.

In the 1946 experiment, the nitrogen application was raised to 120 pounds per acre as a maximum, of which 30 pounds were applied at planting time and the remainder as side dressing when the corn was knee high. Phosphate and potash rates were raised to 80 pounds

(Continued on page 52)

BOOK REVIEWS

DROUGHT, Its Causes and Effects. By Ivan Ray Tannehill. Princeton University Press. xii + 264 pp., illus. 1947.

THERE IS A SAYING in Texas (and in other places as well, perhaps) that "only fools and strangers predict the weather."

Mr. Tannehill does not propose to predict the weather, but he does set forth some theories on causal relationships which, if valid, will aid in foreseeing trends of great practical significance. He deals specifically with droughts, as they affect the national as a whole, though the Great Plains, as the seat of most frequent and critical rainfall deficiencies, receives a lion's share of attention.

It must have taken fully as much trepidation on the author's part to publish his theories relating droughts to variations in solar radiation as it does for the tenderfoot in Texas to name the date of the next rain. After the monumental Yearbook of Agriculture (1941) "Climate and Man," flatly disavowed recognition of any correlation between sunspot cycles and rainfall fluctuations, this thesis has been in general disrepute. Mr. Tannehill brings it to the fore again, and attempts to explain the connection between precipitation on the Great Plains and sunspot activity.

This is not a search for a mere empirical relationship by which future droughts might be predicted by counting sunspots. It is an explanation of how variations in solar radiation may affect rainfall; that these variations are cyclic, if they are, and seem to be related to sunspot numbers, is incidental. The complicated mechanics whereby slight shifts in the relative temperatures of oceans and land masses affect the courses of major air currents in the earth's atmosphere, alter high and low pressure areas, and make for greater or less rainfall in certain areas, are described.

The obvious effort to "popularize" the information falls short of making it easy to read or easy to understand, but some of the conclusions cannot be missed. Among the more striking ones are these:

Variations in the sun's heat are the basic cause of variations in terrestrial weather.

The Pacific Ocean controls the weather of the Great Plains; and weather moves from west to east across the continent.

". . . . There are two kinds of droughts on a national scale. One kind develops in summer and autumn in years when solar radiation is rapidly increasing, and the other kind develops in winter and spring in years when solar radiation in the sunspot cycle is low or rapidly diminishing." Rainfall is deficient at and a year or two after sunspot maxima.

Weather records in the United States show a trend toward a warmer and drier climate.

These and other provocative ideas make the book rewarding reading despite its occasional statistical dullness.

We will now hear from the loyal opposition, who will need to do more than cautiously dismiss the sunspot theory as unproved. Mr. Tannehill presents a challenging hypothesis which demands either to be disproved or accepted.

—Ben Osborn

THE SOIL AND HEALTH. By Sir Albert Howard. Devin-Adair, New York. 320 Pages. 1946. $4.00.

THE AUTHOR HAS A STATED threefold purpose for his book; namely, first, to emphasize the importance of solar energy and the vegetable kingdom in human affairs; secondly, to record his own observations and reflections—accumulated over 47 years—on the occurrence and prevention of disease; and, third, to establish the thesis that most of the disease can be traced to an impoverished soil.

Early in the professional career of Sir Howard—while at his post in India—he gained his first real evidence "that the foundations of all good cultivation lie not so much in the plant as in the soil itself: there is so intimate a connection between the state of soil, i.e., its fertility, and the growth and health of the plant as to outweigh every other factor." His work with Indian crops, especially wheat, afforded such basis of evidence to him.

"The first place in post-war plans of reconstruction must be given to soil fertility in every part of the world," is a needed objective, as viewed by Sir Howard. To this end he points out that the man in the street must do three things:

1. Create examples of what a fertile soil can do.
2. Insist that public meals in which he is interested are composed of the fresh produce of the soil; and,
3. Vote to compel his various representatives—municipal, county, and parliamentary—to see to it that his countries' soil is made fertile and kept so, and that the public health system is based on fresh produce of land in good heart.

Along these lines the author makes his conclusion in a sentence packed to the fullest with real merit: "*The real Arsenal of Democracy is a fertile soil, the fresh produce of which is the birthright of the nation.*" Even though some may differ with Sir Howard regarding the

word "fresh"—leave it out, and few could rightfully fail to applaud so worthy a statement.

The book is compiled principally in four major divisions: Part I—"The Part Played by Soil Fertility in Agriculture"; Part II, "Disease in Present-Day Farming and Gardening"; Part III, "The Problem of Fertilizing", and Part IV, "Conclusions and Suggestions." In these Sir Howard gives a vivid treatise on the balances created by Nature (stressing humus to the fullest) and proceeds to show, by tracing historical agriculture down through (his selected) research records, what man has done in working the land without proper recognition and understanding of Nature's ways.

He traces in some detail the farming systems of England from the 13th century to date, and brings out his points regarding the benefits of humus to yields and leads up to and through what he considers the "two fatal mistakes" in British farming introduced in middle 19th century, namely, introduction and use of artificial fertilizers, and introduction and dependency upon importation of feeding stuffs for livestock. The profit motive in farming, which followed and still exists, has, according to Sir Howard, caused a vicious cycle of ever increasing quantity of production per man with more and more disruption of nature's balance—a short-sighted policy causing "banditry" on future generations; soil erosion and wastage has resulted. He says: "In this he (the farmer) has been the unwilling, but also the rather blind, pupil of an authority he has been taught to respect: the pundits of science have urged him to go forward and have made it a matter of boasting that they have done so."

The author condemns artificial fertilizers, and points out that from Liebig to date, blunders for which experiment stations must be held responsible, have increased. His contention is that the problems of agriculture are a vast biological complex and the usual sub-divisions of science into chemical, physical, botanical and others—first, chiefly for teaching purposes, later for experiments, has been and is a serious mistake.

"If the soil is found to escape the two common ailments—erosion and the formation of alkali salts—which affect cultivated land; and if crops raised resist disease, livestock feed normally and are healthy, people who feed on the crops and livestock are vigorous and disease free—then the method of farming is a success, as advocated by Sir Arthur.

The author's contentions regarding soils (fertility) and disease—especially on health of livestock—appears to the reviewer to lack convincing proof. In fact, repeatedly observations only for what appears to be isolated cases are cited. Some sections ramble without point, for example one on "Concentrates and contagious abortion" (dairy cattle) practically ignores the subject after the opening two paragraphs and praises roughages grown without "artificials" (chemical fertilizers) and condemns concentrates (oil cakes) as rations for the dairy animals. Incidentally, the mid-west American agriculturist may judge it to be a good piece in support of what he may recognize as relating to grassland farming.

In fact, Sir Howard at one place states: "What is needed to bring home to the man in the street the supreme importance of soil fertility as the basis of the public health system of tomorrow are more and more examples of what a fertile soil can do." Later in referring to his chapter on the diseases of the soil, the crop, the animal and mankind, he says: "This recital is of necessity somewhat fragmentary, because such a mass of apparently unrelated detail has had to be described."

In a very short chapter on "The Nature of Disease," Sir Howard concludes that "the heart of the subject (disease) must reside in the proteins." His basis is almost entirely on a premise of Mr. J. E. R. McDonagh, wherein the premise is expounded that: every body is a condensation product of activity, every body pulsates, protein in sap of plants and blood of animals in such a body—the matrix of structures of plants and of the organs and tissues of animals, if soil does not give needed nourishment to plants, the protein over-expands, and this leads to a portion of the protein being broken off which pieces is a virus. In animals and man, it is held, this same principle leads to invasion activity of micro-organisms resident in the intestinal tract. Thus, the rise to disease. His solution, of course, is proper humus in the soil—man's way of effecting climate—imperfectly synthesized protein replaced by normal protein.

Sir Howard admits "artificial manure" (chemical fertilizers) may have a useful, but somewhat restricted, purpose, under only *one* circumstance, namely, where the soil is almost worn out. The inference is, for the purpose of initial restoration so the natural and compost application, improvement methods, advocated by Sir Howard, may be employed.

The author of "The Soil and Health" fails entirely to satisfy even the most elementary questions that may be offered along the lines: What about the economics of farming with and without artificial fertilizers? Not all farms by any manner of means are either large enough or so situated relative to climate or comparative opportunity of enterprises, that they may have livestock to produce compost manure supplies. Likewise, grass and other humus building vegetation in sufficient quantity, and continuously on the same area for numbers of years, can hardly be expected to be the only or most practical solution to needs for fertility maintenance in the economy of this period, over vast portions of many farming areas.

Without answers to the economic respects, Sir How-

ard's principal themes must be taken as only ideals, or possibilities mainly where all the factors of production are equally free and the profit motive in farming is entirely suppressed or absent.

—Melville H. Cohee

New Books

Some of the books listed in this section are to be reviewed in future issues of the Journal. An effort will be made to cover all fields of conservation from time to time in so far as complete reviews are concerned.

Fish Ponds For the Farm, by Frank E. Edminster, is a complete up-to-date manual on how to design, build, stock and manage them. Mr. Edminister also discusses the problems of stocking and managing ponds for maximum yield of fish and their harvest. It is one of the very few books available on this most fascinating of farm enterprises. Charles Scribner's Sons, New York. 1947. $3.50.

The Population of El Salvador and Its Natural Resources and **The Population of Costa Rica and Its Natural Resources** by William Vogt, Chief of the Conservation Section, Pan American Union, Washington, D. C. Mr. Vogt, in each ofthe two paper-bound reports, presents a review of all the natural resources and their condition. He also discusses some of the conservation problems and needs confronting the two countries.

Outline of Waterfowl Management and **Outline of the Principles of Wildlife Management** by Warren W. Chase, Professor of Wildlife Management, and Elizabeth B. Beard, Research Assistant, University of Michigan. Both outlines are "Teaching Aids in Wildlife Management" and should be helpful in the presentation of these subjects, to students. The Overbeck Company, Ann Arbor, Michigan. 1947.

Heaven's Tableland—The story of the dust bowl, by Vance Johnson. This is a tale about man's struggle to control a section of our country known as the Southern Great Plains. It tells o f hopeful invasions and broken-hearted retreats, which for more than eight centuries now have been the central theme of Southern Plains History. It's about the farmer—and the greatest controlling factor of his existence—the weather. Farrar, Straus and Company, New York. 1947. $3.00.

Tht Soil of Yours—by Jim Roe and Edgar Young of *Successful Farming.* The authors of this 73-page book have compiled and edited a series of 31 papers by well-known authorities featuring "Good teeth come first," "It's your soil—keep it!" and "Fertilizer pays." The book is published by Successful Farming, Des Moines, Iowa.

Breaking New Ground is an antobiography of Gifford Pinchot's career from 1889 to 1912. It is the story of how practical forestry came to America, and how forestry, in turn, gave birth to the movement for the Conservation of National Resources. The book also presents the many problems and controversies that made a national issue of conservation. Harcourt, Brace, and Company, 383 Madison Avenue, New York 17. 1947. 522 pages. $5.00.

Educational Films

The Other Side of the Fence is a brand new 16mm Kodachrome sound motion picture just produced and released by Phillips Petroleum Company, Bartlesville, Oklahoma. This movie features Dr. William A. Albrecht, head of the Soils Department, University of Missouri, who personally appears and discusses in a most convincing manner the story of soil and its relationship to the health and well being of people. This picture is vital and interesting to everyone because without exception we eat and live by the soil.

Strips and Curves is a new 16mm full-color sound film on controlling wind and water erosion in the Great Plains region just released by the J. I. Case Company, Racine, Wisconsin. It shows many new farming practices, including stubble mulch farming, strip cropping to control wind and water erosion, and diversification for a steadier farm income. With the full-color field scenes are animated sketches showing the principle of each control measure. Here is the interest-demanding story of modern farming out in America's great wheat-and-cattle country where land is measured by 640-acre sections and soil conservation is being applied on an equally sweeping scale.

Uncontrolled Runoff and Sedimentation

(*Continued from page 23*)

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3. Gottschalk, L. C. Sedimentation in a Great Harbor. U. S. Soil Conservation Service, *Soil Conservation,* Vol. 10, No. 1, pp. 11-12, July 1944.
4. Happ, S. C. Sedimentation in South Carolina Piedmont Valleys. *American Journal of Science,* Vol. 243, No. 3, pp. 113-126, March 1945.
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From the President

WITH EACH PASSING MONTH, the vital role of productive land in the affairs of mankind becomes more clearly apparent. Statesmen as well as great numbers of citizens are beginning to realize, many of them for the first time, that productive land is one of the great keys to the fture. If we can keep enough of it and use it well enough, we will have the basis for a continually broadening standard of living and for pursuit of the noblest goals of life. On the other hand, if we delay too long in facing the fact of limited land, we shall all find ourselves restricted in what we can accomplish. Time that must be spent in the struggle for survival is time taken from the arts and sciences, and from the countless possible explorations of the mind and spirit that together make for the greatest human progress.

These words admittedly deal with wide horizons. But the whole is forever made of many parts. Every terrace and drainage ditch; every conservation photograph and article; every acre planned and treated for permanent use; every bit of knowledge added through research; and every conversation over a fence or anywhere else that adds to a wider, better appreciation of productive land, is a part. By the sum of the parts we can increase the dimensions of the whole. Each of us should remember that it is the aggregate of all the little things we do each day, from day to day, that can add up to a tremendous gain.

Other influences may be dividing the world into opposing camps and other men may be measuring the potentialities of atomic war. Ours is part of the great job of offsetting and eventually outweighing this habit to flirt with death and the dark ages. It is a habit of long-standing and we have come as far as we have with civilization only because, across the centuries, there were always men of good-will and faith who believed that a better tomorrow was worth an effort today.

You can be discouraged by the way the veto is being used in the United Nations, by mankind's failure so far to achieve One World, by the hunger in Europe and Asia, and by the cost of living at home—as well as the seeming slowness of many people to see our point of view—but that is as much a part of our test, as men and conservationists, as the jobs we face daily on the land down the road.

H. S. Bennett

The Soil Association of England

This organization was formed in 1946 by a group of people representing many different walks of life. Its general objectives are somewhat comparable to the Soil Conservation Society of America. This is especially true of the emphasis placed on the importance of health, food and the proper management of land resources. The objectives of the Association are: (1) To bring together all those working for a fuller understanding of the vital relationships between soil, plant, animal and man; (2) To initiate, co-ordinate and assist research in this field; and (3) To collect and distribute the knowledge gained so as to create a body of informed public opinion.

The Association publishes an official Journal entitled *Mother Earth*. It contains 56 pages and features articles that are most enlightening; also regular departments emphasizing Book Reviews, Correspondence, Editorial Notes, Overseas News and Association News. A recent issue of *Mother Earth* contains, among others, the following articles: "The Staff of Life" by L. J. Picton; "More Haste—Less Food" by E. Maurice Wood; "Earthworm Experiment at Haughley" by E. B. Balfour and "Time—Population and the Soil" by T. H. Sanderson-Wells.

The membership reported in the "Association News" appears large. There are more than 150 professions represented. In addition there are members in all the Dominions, several of the Colonies, the United States, Holland and France. The Association plans to produce a documentary film on composting. It also maintains its own research station. There is news that local groups of Association members are getting together in a manner similar to Chapters of the Society.

The "Overseas News" briefly reports the activities of Association members along with local developments featuring soils in New Zealand, South Africa, Canada, United States, East Africa and Rhodesia. It is interesting to note that the item concerning South Africa contains a reference of particular interest to readers of the JOURNAL—"The Veld Trust is forging ahead with its educational campaign, which includes a monthly *Veld Trust News*. The November, 1946, issue contained a most interesting account of the life and work of Dr. Hugh H. Bennett, the well-known chief of the U. S. Soil Conservation Service, who recently visited South Africa. Largely as a result of this visit, and the efforts of the Trust, a Soil Conservation Act has been passed to protect the natural resources of the Union, now seriously depleted."

Lady Eve Balfour is the Organizing Secretary of The Soil Association. Her address is New Bells Farms, Haughley, Suffolk, England.

Field Notes and Comments

Adverse Attitudes in Landstrom's Article Are Not Easily Overcome

To the Editor:

I've just read Mr. Karl S. Landstrom's article "Increasing Farm Income Through Land Improvement" in the October issue of the Journal.

Mr. Landstrom permits himself a wide latitude of assumptions which, I suppose, is necessary to prove the titular contention of his article. At the risk of seeming captious I'm going to take issue with just one of these assumptions.

> "In an area such as this, if there is public understanding of financial advantages of land improvements, adverse attitudes should be relatively easy to overcome."

In one sentence Mr. Landstrom nonchalantly vaporizes the biggest obstacle to a sound program of soil and water conservation in the Glenwood Valley—the "adverse attitude."

Since 1941 a generous sprinkling of technicians have attempted to overcome what really is a hostility. The results have been disappointing. One of the manifestations of this hostility is a resentment against "government men" in general. There are, of course, valley residents whose behavior pattern does not conform to the norm.

Every attempt at group action has failed. Yet the only way the problem in the valley will ever be solved is through group action. What the valley needs is a two-in-one combination—and a rare one it is—a resident who is a trained psychiatrist and soil conservationist. No wholesale conservation measures will ever be undertaken until the root of the hostility or, as Mr. Landstrom would have it, "adverse attitude," is exposed. Only then will there be a large-scale receptiveness for the economic findings in Mr. Landstrom's study.

—G. John Chohlis

Mr. Chohlis touches on an important problem that is common to many communities. Perhaps a leadership analysis of this area along the lines pointed out in Paul Miller's article on page 13 of this issue entitled "A Cultural Basis for Education in Conservation" would overcome the "adverse attitude" problem.—Editor.

Effect of Grass on Invasion of Cedar

A good stand of vigorous climax grasses is nature's best defense against invading weeds, shrubs, and trees. This shows up in graphic detail on two adjoining ranges in the Kerr County Soil Conservation District near Center Point, Texas. Table 1 gives the kind and amount of vegetation on both sides of the fence. The range in fair condition was grazed too closely and is still degenerating. The range in good condition is improving under the present proper management although it too was in much poorer condition several years ago.

TABLE 1. Kind and Amount of Vegetation on Two Adjoining Ranges, Center Point, Texas

Species	Range in Fair Condition Percent Composition	Range in Good Condition Percent Composition
Lindheimer muhly	10	14
Sand muhly	9	2
Indiangrass	3	17
Threeawn	5	2
Sideoats grama	7	2
Sedge	15	4
Fringeleaf paspalum	Trace	
Little bluestem	20	28
Tall dropseed	5	15
Bush sunflower	Trace	2
Rush	Trace	2
Annual forbs	10	2
Annual threeawn	5	2
Annual dropseed	10	8

This area is being invaded by cedar trees. The range in fair condition had 456 cedar trees per acre, whereas there were 196 cedars per acre on the range in good condition. The cedars had invaded the latter earlier when it too had been in fair range condition.

—Dudley T. Mann and Robert S. Hays

Field Days Emphasize Legume Crops

The increasing acceptance by soil conservation district cooperators of legumes as key plants in a coordinated soil and moisture conservation program is proved not only by their widespread use but also by field days to observe and discuss such crops. Typical events:

1. A *kudzu field day* in the Neches-Sabine Soil Conservation District in East Texas was attended by 1,000 persons who observed and discussed the 110 acres of kudzu grown on the farm of Maxie Wilson, a district cooperator.
2. A *hairy vetch field day* near Rising Star, Texas, was attended by 2,500 persons. The visitors saw and talked about this important soil-conserving and soil-improving crop which has meant much to the soil conservation program in the Upper Leon, Brown-Mills and other soil conservation districts of the area. The first hairy vetch was planted by district cooperators in this locality in 1942. Acreage has expanded so rapidly that in 1947 more than 3,500,000 pounds of vetch seed were harvested in spite of a dry season and some insect damage.
3. A *Kob-Esta field day* was sponsored by the East

Central Oklahoma Soil Conservation District, in cooperation with the Stigler Retail Merchants Association and the Stigler Lions Club. This lespedeza festival paid tribute to Kobe lespedeza which is proving to be a valuable crop in this area. The growing use of this legume by the cooperators in the East Central Oklahoma Soil Conservation District is shown by the increase of seed planted, from 2,000 pounds in 1943 to 110,000 in 1947. The East Central Oklahoma Soil Conservation District board of supervisors recently purchased 50 seed-pan attachments for use by district cooperators in harvesting Kobe and sericea lespedeza seed.

4. A *sericea lespedeza field day* was sponsored by the Marion-Cass Soil Conservation District in cooperation with the business men of Atlanta, Texas. Some 700 persons saw and discussed 200 acres of this important soil-conserving, soil-improving, hay and grazing plant on the Davis farm where the field day was held.

In all, about 5,000 attended these field days at which they had an opportunity to learn not only about the legumes but also other phases of the soil conservation district program. Cooperative action and interest such as this is a good example of the progress that is being made in soil conservation districts to check erosion and improve soil productivity.

—W. M. NIXON

Conservation in Central America

Dear Mr. Hull:

I often think of you and the fine work that you are doing. The work in my Soil Conservation Department is improving litle by little. I have, for the present year, eight mules and twelve oxen to pull my equipment used for installing conservation practices. I also have eight men, four of them receiving $100 per month and the others $75 per month.

Yesterday I requested $1,000. I expect to use $700 to buy chains, yokes, harness, etc. The remaining $300 will be used to buy 12 Abney levels to determine percentage of grade. Will you let me know if Dietzgen Company, 407 Tenth Street, have any levels on hand?

I'll send you some pictures of the work we are doing here in Guatemala.

—MARCOS OROZCO M.

Most of us feel that we are hindered in carrying out our job unless we have all the proper equipment and tools with which to work. Mr. Orozco is going ahead as he says "little by little" with what he can get. He is Chief of the Department of Soil Conservation in Guatemala. Mr. William X. Hull is Foreign Liaison Representative for the Soil Conservation Service.—EDITOR.

The "Grass Roots" of Conservation . . .

Terraces, paved outlets and numerous other engineering structures are highly important in soil conservation, but not always essential. A complete conservation program can involve much simpler methods and be just as effective in rebuilding soil fertility—and the "average farmer" can derive an adequate family income.

Don Roberts of Mahomet, Illinois, is an example of one farmer who didn't follow *all* of the "orthodox" methods, but nevertheless, is building up his soil and getting good returns.

On $50 land on which he has spent $25 an acre to build up the soil, he produces 80 bushels of oats and over 100 bushels of corn per acre. This build-up consists very briefly of something like this: bull-dozing off brush; filling up gullies—which leaves a lot of "unorthodox" yellow clay subsoil on the surface; disking—this is cutting and pulverizing to a depth of three or four inches with a heavy tractor disk; applications of limestone, fertilizer and manure, interspersed with more disking.

One of the conservation method which is proving to be effective on his rolling, hilly farm is the maintenance of broad grass waterways where needed. Roberts says that run-off and erosion are practically nil. He thinks the reason for this good control lies in the tilthing effect of the grass roots, deep penetrating alfalfa roots and residues resulting from adequate fertilization and high yields. This excellent physical soil condition enables the soil to soak up rapidly large amounts of water. Roberts' plowing and tillage operations are performed on the contour with a disk plow, which also encourages water absorption rather than run-off.

As a part of his farming program, Roberts sows alfalfa, bromegrass and ladino clover in August. He maintains this pasture-meadow indefinitely by pulverizing each summer and topdressing with 500 to 600 pounds of 8-8-8 mixed fertilizer. He reseeds at half the initial rate. Also as a part of his farming program, Roberts sows sudan grass for summer pasture.

With this pasture program, he has a herd of 100 purebred Guernseys. He had two top producers in the Champaign Dairy Herd Improvement Association in June. Their records for the month were 1,861 and 1,826 pounds of milk and 88 and 85 pounds of butterfat. All the feed and roughage for the livestock program is raised on the farm, with some left over to sell. The home-grown grains are ground on the farm and only supplements are purchased.

Here's a farmer who's getting good results from a principally grassland conservation program which did not require a "fortune" to finance.

—WARREN C. HUFF

Dual Curve Illustrates Results of Soil Conserving Practices

An accomplishment curve superimposed on a normal curve has been used by the writer to indicate results of establishing new soil conserving crops in the Southeastern United States. The dual curves were favorably received by an audience of Zone Conservationists and Division Chiefs at Spartanburg, S. C. Suggestions were received that the method might be extended to other soil conserving practices. A brief description of the method used in constructing the curves has been prepared with the hope others may find it useful.

The construction may be considered in four steps.

The first is drawing a normal curve on the scale desired using a dotted line and disregarding the portions beyond three standard deviations from the middle. The specifications of the normal curve, technically the normal curve of error, or an illustration of it are to be found in nearly all books of mathematical statistics.

The second step is the decision of number of classes to be used. An odd number, either three, five, or seven has the advantage of a middle class with equal numbers on each side. Three classes could approximate (1) failures and near failures (2) moderate successes and (3) complete successes. Five classes could approximate (1) failures (2) below average (3) average (4) somewhat above average and (5) almost perfect. Seven classes could approximate (1) complete failures (2) near failures (3) low successes (4) average successes (5) slightly above average successes (6) much above average successes and (7) perfect successes.

With a decision on number of classes to be used, the normal curve is divided into a similar number of equal base parts. The percent total area in each can be taken from a table of areas under the normal curve of error. For three divisions corresponding to three classes the percents are 16, 68, 16 respectively; for five divisions, 4, 24, 44, 24, 4 and for seven, 2, 8, 23½, 33, 23½, 8, 2, respectively. The approximate percent is entered on the normal curve directly above the midbase of each part.

The third step is the classification of reports concerning the soil conserving practice under consideration. Each report, when classified, is entered in the appropriate class. The totals of each class and of all classes are counted. The percent in each class is calculated.

The fourth step is location and construction of the accomplishment curve. The points of this curve correspond to the percent occurrence in each class determined in step three. Each point is located proportionately above, below, or on the corresponding value entered on the normal curve in step two. When each of the points has been located, the points are connected by a free-hand curve using a solid line. This is the accomplishment curve. If it is to the left of the normal curve, the accomplishment is regarded below normal expectation; if to the right, above normal expectation.

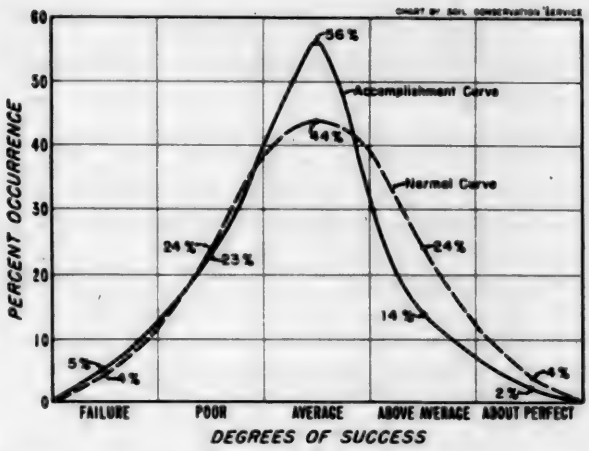

Figure 1. A dual curve illustrating the success of establishment of Pensacola Bahia grass in the Southeastern United States in 1946 and the departure from "normal."

An illustration of the dual curves is shown in Figure 1. The accomplishment curve there was secured from 150 reports of establishing Pensacola Bahia grass in the Southeastern United States. It is almost identical with the normal curve in the lower left portion, indicating normal expectation of failures and low successes. It is to the left of the normal curve on the lower right portion, indicating below expectation of complete successes or near complete successes, possibly due to slow development of seedling plants of this species. The average or middle portion is above normal.

To accompany the dual charts, summaries of reported causes of failures and poor successes and of complete successes were made. By avoiding causes of failures as far as possible and by utilizing causes of complete successes, field work may be so improved that the curve of accomplishment will be to the right of the normal curve at all points.

— PAUL TABOR

Deterioration in Properties of Soils

Deterioration in the physical properties of soils began with the using-up of the organic residues of the forests that originally covered the entire state and with the closing-up of the holes that had been made by the roots of the trees. It has grown more serious with the increasing agricultural age of the land and with the ever greater intensity in the use of tractors and machinery of the heavier types. Much of the land is being worked too early in the spring, too soon after rains, and too frequently, both as related to the number of machine operations for any given crop and the percentage of the time the fields are under cultivation.

The symptoms of physical deterioration have been evident for some years. Gully and sheet erosion, with consequent loss of topsoil, marked the starting point. Other evidence soon appeared in the increase in number and size of wet spots, the development of plowpan, the tendency of the surface soil to run together to form a hard crust, and the failure of deep-rooted and perennial crop plants to thrive. Such remedies as the use of chisels and subsoil plows, the incorporation of lime and superphosphate into the openings made by these implements, and the use of gypsum are now being applied.

The time has arrived when a great deal more consideration must be given to deeper plowing and to the use of correspondingly larger amounts of soil amendments. We need to increase the amount of topsoil by deep incorporation of liming materials and crude types of organic matter. We need to grow more tap-rooted legumes that open up the subsoil and leave air channels and organic residues at greater soil depths than do ordinary crop plants. We need to make more use of such crops as sudan grass and sorghums for midsummer drying-out of irrigated soils. We need to turn under more fresh green cover-crop material on sandy soils for the purpose of sticking them together. We need to plow down more coarse material, like cornstalks, on the heavier types of soil to loosen them up.

The overall task involves the building up of the structural and fertility levels of about two plow depths of soil. This permits of a greater volume of soil in which the roots can forage, protection against excess water and the formation of toxic substances during wet spells, and prevention of drought injury when the weather is dry. In proportion as we permit of the formation of plowpan, the consolidation of the subsoil, and the development of conditions that are unfavorable for the growth of deep-rooting plants and for the activities of earthworms, the less the likelihood that full effects from the use of fertilizers will be obtained.

—FIRMAN E. BEAR

Recent Research Reviews

(*Continued from page 44*)

each, and stands were adjusted at 4,000, 8,000 and 12,000 per acre. There was an increase in yields of about one bushel of corn per acre for each two pounds of nitrogen as fertilizer.

Increasing the number of plants without sufficient nitrogen reduced the size of the ears, but when nitrogen and stand rates were raised at the same time, the ears were at least as large as those produced by the usual farm practices.

Except on most fertile soils more plants than usual should not be grown unless high rates of nitrogen are used. Even with 30 or 40 pounds of nitrogen per acre, when the stand was increased above that usually left in the field, the yield usually went down. It was only with 60, 90, and 120 pound rates of nitrogen that the heavier stands were profitable.

The work to date indicates 90 pounds of nitrogen and 10,000 plants per acre is a satisfactory combination. About one-third of the nitrogen should be applied at planting time, and the remainder when the corn is knee high.

There was less grass and weed growth in the well fertilized heavy stands, and less cultivation was needed.

Soil Erosion and Fertilizer Response. *By* JOHN LAMB, JR. *Fertilizer Review, Vol. 21, No. 3, pp. 12-13. July-Aug.-Sept. 1946.*

Recent experiments at different locations and under varying soil types show that loss of topsoil has been associated with unsatisfactory response to fertilizer in addition to reduction in crop yield. It is imperative that erosion control become part of the general farm practice, to insure maximum crop yield and highest efficiency of plant food applied.

Data are reported from Marcellus, Geneva and Ithaca, N. Y. bearing on this point.

New Production Methods with Rice. *U.S.D.A. Yearbook of Agriculture, 1943-1947—Science in Farming.*

Either application of fertilizer or additions of soil organic matter can make rice grow better. A combination of the two makes rice try to jump out of its root, reports Jenkin W. Jones, of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

The usual system of rice and native pasture gives an average yield of about 45 bushels per acre. Fertilizers increase that figure five bushels; four years of improved pasture between rice crops raises the yield about 12 bushels more, and fertilization, in adidtion to improved pasture, lifts the yield about 27 bushels. Besides, on such pastures, organic residues are returned to the soil and

(*Continued on page 54*)

Graded-channel terrace to be built

Outlet to be filled

Level terraces to be built

Ditches to be cut

Water outlets to be constructed

there's a **JOB** to be done

Lots of Earth to be Moved

What tools are used to do the job is relatively unimportant; the important thing is to get it done with all possible speed. Much work can be done successfully with light equipment; but, when there is a lot of earth to be moved, and when the nature of the work varies tremendously, as in the accompanying photographs, it seems the part of wisdom to call in specialized, high-powered earth moving equipment like this most modern of Power Graders, with its All-Wheel Drive for maximum traction and All-Wheel Steer for maximum maneuverability. We will gladly discuss its application to your problems.

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BUILDERS OF ROAD MACHINERY SINCE 1859

Austin Western

Conservation on Western Ranges

(*Continued from page 40*)

ranch. Specific practices and remedial measures are specified for both the cropland and the grazing lands.

OTHER FACTORS TO BE CONSIDERED

Planned conservation programs on rangeland usually include three or more of the following practices: Season of grazing use adjusted to be in harmony with plant growth requirements for optimum yield, deferred-rotation grazing, seasonal adjustment of livestock numbers grazed, locations for erection of division fences, so as to make rotational grazing and proper seasonal grazing possible. Also considered are location of sites for range reseeding, development of livestock water and of salting stations to insure even distribution of grazing. The provision for annual inspections of the grazing land upon which are based the seasonal adjustments in numbers of livestock grazed, or adjustments in season of use, as the forage growth and development may be influenced by local climatic factors, provides flexibility in the plan.

Examples of conservation practices planned for cultivated land on many ranches are specific crop residues on the land over winter, only the best use of adapted crops for hay, silage, and concentrates; drainage; irrigation; strip cropping; fertilization; and subsurface tillage.

A TYPICAL RANCH

An example of problems found and the practices designed on a western cattle ranch of approximately 2,000 acres is portrayed on two land-use maps found on the following pages. One map was made before, and the other after, the rancher had developed a ranch conservation plan.

Important changes and improvements made on this ranch on the basis of an inventory such as have been described above included:

1. Reduction of breeding herd from 300 cows and 14 bulls to 200 cows and 8 bulls.
2. Provision for keeping bulls in separate pasture except for a two-month period—July 1 to August 31, when bulls are run with cows.
3. Fencing range into four units with stock water provided so that a deferred rotation system of grazing could be followed.
4. Leveling and reseeding 250 acres of native hay meadow.
5. Redesign of irrigation system for hay meadow.
6. Crop land divided into units with five-year rotation consisting of three years cereal grain and two years sweet clover planned for each unit.
7. Market cattle to be sold as even aged yearlings instead of mixed ages, ranging from one to three years old.
8. 420 acres of depleted range fenced and seeded to crested wheat grass.

Some Indicated Results

Evidences of improved production upon this ranch after the plan has been in operation four years are:

a. Increased calf crop from 60-89 percent.
b. The rancher is producing all the winter feed he requires, where formerly purchased more than 100 tons annually.
c. Less hired help is required than formerly.
d. The range is improving and yielding more forage than it had produced for many years.

The operator, in this instance, feels that the annual forage yield on his range land, under present practices, will eventually be three times that which it produced before he reorganized his operations.

Recent Research Reviews

(*Continued from page 52*)

cause the rice to respond better to fertilizers.

The production of beef per acre is two to four times as much on improved fertilized pastures as on unfertilized native pasture. Improved pastures also have at least 50 percent higher carrying capacity and supply good grazing for a longer period each year. The calf crop on improved pastures is a fifth greater than on ordinary pasture. Obviously, then, a more extensive use of improved pastures for grazing with rice, promises well for the Gulf Coast Section.

Good Pasture Saves Corn! *By* MAURICE L. PETERSON, G. M. BROWNING *and* REX BERESFORD. *Iowa Farm Science, Vol. 1, No. 9, pp. 14, 15 and 16. March 1947.*

One acre of bromegrass-alfalfa saved from 10 to 22 bushels of corn and cut the hay and protein needs in half in a test last year with feeder cattle on grass. But it took a longer time to fatten the cattle on pasture. And under normal conditions, this delayed marketing may be accompanied by a seasonal decline in prices received for fat cattle.

A Patriotic Duty

It it much more important, I believe, to teach the children that the United States of America is *Eight* inches deep than it is to teach them the length and breadth of the United States of America. After the depth is gone, we will not be in a position to teach the children of America anything.—HARRY HAGEROTT.

Champion Farmer Buerman uses Firestone Champion Ground Grips on his tractors, because they clean up to 100% more effectively, pull up to 62% more, last up to 91% longer, and roll smoother over highways.

Only Firestone builds tractor tires with connected curved traction bars. Curved bars are stronger . . . like a curved roof. They're braced . . like a corner fence post. They cut into the soil with the cleaving, cleaning action of a plowshare. The tapered openings between the bars throw out mud and trash.

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Champion Farmer

MORRIS BUERMAN Uses

Firestone

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ANY OTHER TRACTOR TIRE

FIFTY TONS OF CHERRIES! That is the average annual harvest of Champion Farmer Morris Buerman, Sodus, New York. His apple trees annually bear 12,000 bushels, and his peach trees, 1200 bushels. As "The Voice of Cherry Growers" on a series of radio broadcasts, Champion Farmer Buerman contributed much to increase the market demand for cherries. The National Cherry Growers Association is an outgrowth of his local association in which he has been extremely active. Champion Farmer Buerman naturally prefers Firestone Tires for his equipment.

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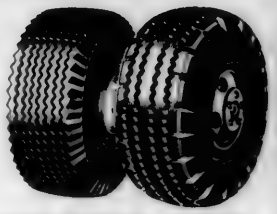

DELUXE CHAMPION PASSENGER

TRANSPORT TRUCK

"Our Changing Land Policy"

(*Continued from page 12*)

they will be. The changing attitude toward the land, evident over the country, can become an irresistible movement. An increasing number of men in Washington—Clifford R. Hope, Ben Jensen, Senator Ed Thye, Secretary Clinton Anderson, to name but a few—understand the importance of our soil resources to the welfare of the nation. Perhaps from among them will arise a new Statesman of the Land to write his name above even that of Benton.

LAND POLICY MUST BE INCLUSIVE

Yet we might as well be honest about this job of conserving our soil and water resources. It's something of which everybody speaks highly—and lets it go at that. So far as real effort is concerned we've just been using a boy to do a man's job—or rather dividing it up among two boys. It isn't going to be done right until we're committed to it in a national land policy that allows no further evasion. Some of us have worked out this outline by which such a policy might be stated: *"That it is hereby recognized that the conservation and maintenance of our basic food-producing resources are essential to the national security and to the physical and economic well being of the American people; that the wastage of our soil and water resources, resulting from soil erosion, loss of soil fertility, flood damage and the silting of our streams, lakes and reservoirs, has become of critical national concern; that the enactment of a permanent national land policy, for the purpose of conserving these basic resources, is necessary to prevent their further exhaustion and the consequent endangering of the national security and the physical and economic well-being of the American people; and that this national land policy shall be established and used as a foundation for other agricultural policies and programs."*

Such an enactment, stated in those terms, really commits us to do the job and should give us the tools with which to do it. All of us can see the useful results it would have. I shall cite some them: It would command public support because it represents a manifest public interest; it would provide a practical and defensible basis for the payment of benefits in any future farm program; it would act as an effectual check upon any near-time crop surpluses, while insuring our ability to produce more when it is needed to feed our growing population or to meet emergencies; it would expedite flood control and reduce the public expense caused by the silting of streams and reservoirs; it would make possible an upgrading of the American diet and give the people more of the kind of foods they have shown they want—the foods rich in minerals, vitamins and the first class proteins (for a good land policy is a necessary preliminary to a good food policy); and it would eventually stop this insidious loss of irreplaceable national resources.

I am not a believer in conservation just for conservation's sake. I believe in it because I recognize in it a co-worker with the laws of nature, and of nature's God, as revealed to us in the processes by which the earth was made productive. And there is still another reason. We are engaged on this continent in an experiment with a form of society in which men and women may live and think and work and worship in freedom. I want it to have that chance.

A Successful Soil Conservationist

To be a good soil conservationist a man should have a deeply ingrained love for the land and a thorough appreciation of the need for using wisely all of our basic natural resources.

He should be physically capable of handling himself in all kinds of weather and in driving and walking over all kinds of rough terrain, climbing hills and over fences.

He should be able to deal with all kinds of people, in order to persuade them to adopt conservation measures and help them with their problems. He is called upon to meet with boards and commissions, address public meetings and conduct business meetings of all kinds.

He should be a man of integrity and intelligence who is emotionally stable and can win the confidence of practical farmers and ranchers. He should be practical and industrious, not afraid to get his hands or clothes soiled on occasions to lend a helping hand to get the job done.

They Never Skip a Dividend!

A district board of supervisors in Michigan.

That's the way we feel about the supervisors of soil conservation districts everywhere. They constitute one large board of directors who never meet without paying a dividend. Payments come in the form of an ever-growing program for better soil maintenance.

The soil conservation districts now organized—nearly 2,000 of them—constitute a "snowball" that has gathered weight and strength and momentum for a big job. John Deere is glad to help farmers in every possible way, for they have been our friends—for more than a hundred and ten years.

Our new motion picture, "Keep Your Eye On The Soil," is being shown at John Deere Days all over the country. We invite you to see it.

JOHN DEERE MOLINE, ILLINOIS